DOCUMENT RESUME

ED 270 571 CE 044 423

TITLE	Building Trades. Block VIII. Interior Trim.
INSTITUTION	Texas A and M Univ., College Station. Vocational Instructional Services.
SPONS AGENCY	Texas Education Agency, Austin. Dept. of Occupational Education and Technology.
PUB DATE	85
NOTE	207p.; For curriculua on foundations, floor framing, and wall framing, see ED 239 104, ED 256 954-955, and CE 044 422.
AVAILABLE FROM	Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843 (Order #05408--$11.00).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Behavioral Objectives; *Building Trades; *Cabinetmaking; *Carpentry; Construction (Process); *Finishing; Job Skills; Learning Activities; Lesson Plans; Postsecondary Education; Secondary Education; Student Evaluation; *Trade and Industrial Education; Woodworking

ABSTRACT

This curriculum for interior trim provides instructional materials for 18 informational and manipulative lessons. A list of 11 references precedes the course materials. The instructor's plan for each informational lesson begins by providing this information: subject, aim, required teaching aids, required materials, references, and prerequisite experience of the learner. Components of the instructor's plan include preparation of the learner (motivation), presentation of information, application (teacher and student activities), verification and/or evaluation (final check on student's comprehension of materials presented), summary, and suggested reading for students. Information sheets and assignment sheets are provided as needed. The instructor's plan for a manipulative lesson begins with this information: task, aim, tools and equipment needed, materials needed, teaching aids, references, and checking standards. Components of the plan include preparation, presentation of the skills, application (practice by learner under close supervision), verification and/or evaluation, summary, and suggested reading for students. A job sheet and task sheets are provided. Topics covered include thermal insulation; acoustical insulation; insulation installation; drywall construction; gypsum wallboard installation; wall panels; wood paneling; wood flooring; resilient tile flooring; kitchen/bathroom cabinets; and base, ceiling, and wall molding and their installation. (YLB)

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BUILDING TRADES

BLOCK VIII

"INTERIOR TRIM"

DEVELOPED
BY
VOCATIONAL INSTRUCTIONAL SERVICES
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ACKNOWLEDGEMENT

Appreciation is extended to Dr. James Dean, New Mexico State University , who contributed his time and talents in the research, planning, and writing of this Course of Study for Interior Trim Installation.

Special thanks are extended to the typing, illustrating, and printing staff at Vocational Instructional Services for their time and efforts in the production of this publication.

MAJOR BLOCK VIII - INTERIOR TRIM

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CORRELATION OF INSTRUCTIONAL TOPICS TO ESSENTIAL ELEMENTS

The curriculum for Building Trades - Interior Trim includes the essential elements common to all vocational education programs as listed under S_s75.81 (a)(2) and those essential elements common to all trade and industrial education programs as listed under S_s75.91 (a) including the essential elements for building trades as listed under S_s75.91(e).

VOCATIONAL EDUCATION

*Topics of Instruction	*S_s75.81 Essential Elements
A. Employment	(a)(2)
1. Desirable employee characteristics	(a)(2)(C-H)
a. Individual employee work habits	
(1) Ability to take and follow both oral and written directions	(a)(2)(C)
(2) Ability to work harmoniously with others	(a)(2)(F)
(3) Development of responsibility and ability to follow through on assigned tasks	(a)(2)(G)
b. Functioning in the work place	
(1) Punctuality and dependability	(a)(2)(D)
(2) Observation of rules and standards	(a)(2)(E)
(3) Productive work habits and attitudes	(a)(2)(H)

*NOTE: The development of these topics are provided through the performance of jobs assigned with each topic listed under the essential elements common to trade and industrial education S_s75.91 (a) and the essential elements for building trades as listed under S_s75.91 (e).

TRADE AND INDUSTRIAL

Topics of Instruction	S_s75.91 Essential Elements
Minor Block	
A. Insulation	(e)(1)
1. Identification of Materials	(e)(1)(D)
2. Materials Cost Estimation	(e)(1)(C-D)
3. Installation of Materials	
4. Tools	(a)(2)
a. Identification	
b. Use	
c. Care	
5. Safety	(a)(1)(A-D)
6. Blueprint Reading	(e)(1)(B)
B. Drywall Construction	(e)(1)(K)
1. Drywall Materials	(e)(1)(D)
2. Materials Cost Estimation	(e)(1)(C,D)

Topics of Instruction	Ss75.91 Essential Elements
3. Drywall Installation	(e)(1)(E)
4. Tools	(a)(2)
5. Safety	(a)(1)(A-D)
6. Blueprint Reading	(e)(1)(B)
C. Wall Panels	(e)(1)(A)
1. Types of Wall Panels	(e)(1)(D,E)
2. Material Cost Estimation	(e)(1)(C,D)
3. Wall Panel Installation	(e)(1)(E)
4. Tools	(a)(2)
5. Safety	(a)(1)(A-D)
6. Blueprint Reading	(e)(1)(B)
D. Flooring Installation	(e)(1)(A,B,C,D,E)
1. Flooring Materials	(e)(1)(D,E)
2. Material Cost Estimation	(e)(1)(C,D)
3. Wood Floor Installation	(e)(1)(E)
4. Resilient Floor Installation	(e)(1)(E)
5. Tools	(a)(2)
6. Safety	(a)(1)(A-D)
7. Blueprint Reading	(e)(1)(B)
E. Cabinet Installation	(e)(1)(A,B,C,D,E)
1. Cabinet Construction	(e)(1)(A-E)
2. Material Cost Estimation	(e)(1)(C-D)
3. Installation	(e)(1)(E)
4. Tools	(a)(2)
5. Safety	(a)(1)(A-D)
6. Blueprint Reading	(e)(1)(B)
F. Base, Ceiling, and Wall Trim	(e)(1)(A-E,K)
1. Molding	(e)(1)(D)
2. Material Cost Estimation	(e)(1)(C-D)
3. Installation	(e)(1)(E)
4. Tools	(a)(2)
5. Safety	(a)(1)(A-D)
6. Blueprint Reading	(e)(1)(B)

BLOCK VIII - INTERIOR TRIM

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"Competency Profile for Building Trades", Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843.

"Competency Profile for Carpentry", Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843.

* State adopted text.

SUBJECT: Thermal Insulation

AIM: The student will be able to identify the general types or forms of insulation. The student will further be able to calculate material quantities, cut and install insulation.

TEACHING AIDS: Information Sheet VIII-A-1(IS), chalkboard, chalk, film (From Glass to Fiberglass)

MATERIALS: Various samples of materials and types or forms of insulation commonly used in building trades

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 13
Jones, R.P. and J.E. Ball, Framing, Sheathing and Insulation, Unit 24
Watson, D.A., Construction Materials and Processes, Unit 9

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must meet the prerequisites set forth by the local district and the Texas Education Agency for all vocational students. The student must further display a sincere interest in learning the building trades and skills as a career choice.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

As all materials increase in thickness, their ability to resist the transfer of heat increases. However, with today's construction practices and the weight of materials limits the thickness of building materials that may economically be used. For the above reasons and skyrocketing utility costs, the loss of heat from buildings in the winter and the gain of heat in summer is controlled by thermal insulation such as spun glass, foamed glass, vegetable fibers, mineral fibers and certain foamed plastics.

Today, a high level of comfort is obtainable in our homes and commercial buildings, through the use of modern insulating materials. The successful operation of heating and air conditioning systems depends to a large extent on adequate and properly installed thermal insulation. Insulation in all types of buildings is essential, whether located in the colder northern regions or in the warm southern regions.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTORS TO DO OR SAY
A. Insulation Passout: VIII-A-1(IS)	1. Substance which is a nonconductor 2. Lightweight 3. Depends on multitudes of tiny air pockets a. Heat travels with difficulty through air b. Heat always moves toward a cooler area

B. Functions of Insulation

1. Prevents rapid changes in temperature
2. Reduces fuel costs
3. Retards the spread of fire
4. Tends to prevent excessive condensation

C. Insulation Materials (Show Examples)

1. Mineral
   a. Rock
   b. Slag
   c. Glass
2. Vegetable or natural
   a. Processed wood
   b. Sugar cane
   c. Corn stalks
   d. Certain grasses
3. Plastic
   a. Polystyrene
   b. Rubber
4. Metallic
   a. Very thin plate of tin, copper or aluminum
   b. Aluminum foil on rigid fiberboard or plasterboard

D. Types or Forms

1. Loose-fill
   a. Blown or poured into spaces
   b. Bags or bales

NOTE: Blown-fill insulation work is generally performed by an insulation contractor and should not be attempted by any person unless he is properly safeguarded against the inhalation of particles of insulating materials

2. Flexible, fibrous - assorted widths and thicknesses to fit standard spacings
   a. Blankets - 30' to 80' long rolls
   b. Batts - 2', 4', or 8' lengths
3. Rigid - pressed boards 1/2" to 1" thick, wide range of sizes
   a. Wood fiber
   b. Cane fiber
   c. Mineral wool
   d. Cork
   e. Glass fiber
   f. Foamed glass
   g. Foamed plastic
4. Reflective or metallic - to be effective, reflective surface must be exposed to an air space
   a. Metal foil
   c. Foil-surfaced materials

E. Qualities of Insulation Materials

1. Fireproof
2. Moisture proof

3. Vermin proof
4. Resists physical change

F. Selection of Insulation Materials

1. Initial cost
2. Effectiveness
3. Durability
4. Adapts form to that of construction and installation methods

G. Heat Transmission Methods

1. Conduction
2. Convection
3. Radiation

H. Thermal Insulation Terms (Define)

1. BTU
2. k
3. C
4. R - high value, better insulation properties
5. U - lower value, better insulation properties

NOTE: See Information Sheet VIII-A-1(IS)

I. Vapor Barriers

1. Purpose and function - protection from moisture
2. Barrier materials
   a. Asphalt-coated paper
   b. Aluminum foil
   c. Polyethylene films - 2 to 4 mil
   d. Various combination of these materials
3. Installation
   a. Always place vapor barrier on the warm side to control moisture movement
   b. Flange or tabs on the side are for attachment

J. Estimating Materials thickness

1. Figured on the area (square feet) and
2. Formula for figuring area:
   Length(ft.) x width(ft.) = Area (sq. ft.)
   Example:
   20' x 30' = 600 sq. ft.
3. Formula for figuring cubic feet:
   Length(ft.) x width(ft.) x thickness(ft.) = cu. ft.
   Example:
   20' x 30' x .5'(6"/12) = 300 cu. ft.
4. Exterior walls
   a. Add total perimeter of building
   b. Multiply by ceiling height
   c. Deduct area (sq. ft.) for doors and windows, optional

Example:
Perimeter = 40' + 50' + 40' + 50'
= 180'
Area = 180' x 8'(ceiling ht.)
= 1,440 sq. ft.
Net area = 1,440 - sq. ft. for windows & doors
= X number of sq. ft.

d. Batts are supplied in packages containing as much as 100 sq. ft.

5. Floors and ceilings
   a. Figure sq. ft. of floor or ceiling (should be the same) area for blanket or batts

Example:
Area = 40' x 50' = 2,000 sq. ft.

   b. Figure cu. ft. for loose fill insulation

Example:
cu. ft. = 2,000 sq. ft.(area) x .5 thickness
= 1,000 cu. ft.
no. of 4 cu. ft. bags = 1,000 ÷ 4
= 250 bags

K. Related Safety

1. Apparel
   a. Long sleeve shirt that buttons around the neck
   b. Gloves
   c. Respirator or filter masks
   d. Safety glasses
   e. Hard hat
2. Tools and equipment
   a. Claw hammer and nails
   b. Staple gun (power or hand)
   c. Razor blade or hook knife
   d. Straight edge and pencil
   e. Pocket tape
   f. Respirator or filter masks

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES PARTICIPATING IN DISCUSSION.)

1. Have students identify various types or forms of insulation.
2. Ask oral questions concerning basic thermal insulation terms.
3. Work example problems estimating insulation materials needed as required in building plans.
4. Students complete Assignment Sheet VIII-A-1(AS).

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

True-False

1. Insulation helps reduce fuel costs considerably by retaining heat in the building.	True
2. Mineral, vegetable or natural, plastic and metallic are the general materials used for building insulation.	True
3. Loose-fill insulation is commonly sold in the blanket or batt form.	False
4. Blanket insulation with a vapor barrier is always installed with the vapor barrier toward the cold side of the wall.	False
5. A good insulation material should be fireproof, moisture proof, vermin proof, and resist physical change.	True
6. The initial cost of insulation is a major factor in the selection of insulation materials used in construction.	True
7. The transmission of heat from one material to another that are in direct contact is called convection.	False
8. A good insulation material will have a high "R" value.	True
9. The use of insulation to prevent heat loss is not necessary in the warm southern regions of the United States.	False
10. When working and handling insulation materials, one should dress properly to protect themselves.	True

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

All building materials resist the flow of heat to some degree, depending on their porosity or density. Today, commercial insulation materials are generally classified into four main divisions: mineral, vegetable or natural, plastic, and metallic.

Insulation is made in a variety of forms and types. The most common are loose-fill, flexible and fibrous, rigid and reflective or metallic. Good insulation should be fireproof, moisture proof, vermin proof, and resist to physical change.

Selection is based on initial cost, effectiveness, durability and the adaptation of its form to that of the construction and installation methods.

The transfer of heat takes place by one or more of three methods: conduction, convection, and radiation. Basic terms to keep in mind are BTU, k, C, R, and U and their relationship to heat transfer.

Vapor barriers must be located on the warm side to prevent moisture from moving through the insulation to the cool side and condensing.

Insulation material may be packaged by the square foot or by the cubic foot. To calculate square feet or cubic feet use these formulas:

Length(ft.) x width(ft.) = square feet

Length(ft.) x width(ft.) x thickness(ft.) = cubic feet

The handling and installation of insulation materials requires careful attention be given to the proper safety apparel and using correctly the right tool for the job.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Chapter 13

THE NEXT LESSON IS: VIII-A-2-(I) "Acoustical Insulation"

INFORMATION SHEET VIII-A-1(IS)
ON
INSULATION MATERIALS

SUBJECT: Thermal Insulation

INTRODUCTORY INFORMATION:

In modern construction of homes and buildings, a high level of comfort and economical operation of heating and cooling units is made possible through the use of modern insulation materials. Utilities cost can be lowered in the winter for heating and the summer for cooling when the home or building has been properly insulated. Size requirements of heating and cooling units can also be reduced.

Building codes of states, counties and local municipalities have now established minimum "R" value requirements for insulation used in construction. As a carpenter, the student(s) of building trades may be required to handle and work with insulation. The student(s) needs to have a sound working knowledge of insulation materials: types, amounts, cost, installation, and other aspects that apply to its selection and use.

GENERAL INFORMATION:

FUNCTIONS OF INSULATION

Thermal insulation is used in modern homes and buildings to retard or minimize the movement of heated or cooled air. Therefore, the successful operation of heating and air conditioning systems depends to a considerable extent on the correct use of insulation materials.

The functions of thermal insulation in modern construction are:
1. Prevents rapid changes in temperature of a building in both summer and winter, thus making the building more comfortable for either work or play.
2. Reduces energy costs by a noticeable amount for heating and cooling. Insulated buildings can generally use smaller heating and cooling units than those uninsulated.
3. Retards the spread of fire in a building. Some insulation will not burn under any conditions, while other types burn very slowly, even when subjected to intense heat.
4. Tends to prevent excessive condensation that could cause permanent damage to structural members, discoloring of wall surfaces and paint peeling.

INSULATION MATERIALS, QUALITIES AND SELECTION

Commercial insulation materials used in today's modern construction are made of glass fibers, glass foam, mineral fibers, organic fibers and foamed plastic. Insulation materials are generally classified into four main groups: mineral, vegetable or natural, plastic, and metallic.

Mineral insulation is made of rock, slag, and glass. After grinding and melting these materials, they are blown into a fine, fluffy mass of fibers. Vermiculite, a lightweight material, is produced when heated. In this process, mica expands and explodes into granules about fifteen times their original size.

Vegetable or natural insulation is made from processed wood, sugar cane, corn stalks, and certain grasses that have been chemically treated with a fire retardant. Also included in this group is cork, redwood bark, sawdust, and shavings.

Plastic insulation is made from polystyrene and synthetic rubber. Polystyrene is a foamed chemical plastic that is inexpensive to produce. Rubber insulation is made from synthetic rubber containing cells filled with nitrogen.

Metallic insulation is made of very thin tin plate, copper, or aluminum sheets. Aluminum foil is also used on the surface of rigid fiberboard or plasterboard.

Good insulation should be fireproof, vermin-proof, moisture proof and resistant to any physical change that would reduce its effectiveness against heat transfer.

Items that should be considered when purchasing or selecting insulation materials are initial cost, effectiveness, durability, and the adaptation of its form to the construction and installation methods.

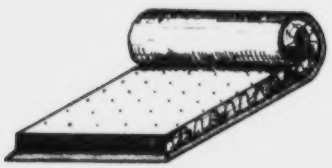
TYPES OR FORMS OF INSULATION

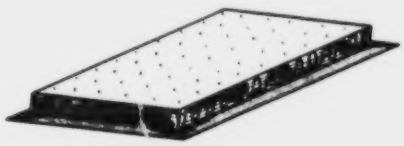
Insulation is produced in a wide variety of forms and types and can be purchased in four general classifications. They are:

1. **Loose-fill** insulation is supplied in bags or bales. It can be placed by hand, poured, or blown into spaces between studs and ceiling joists. Build up is possible to any desired thickness in attics after the ceiling below has been finished. Loose-fill insulation conforms to irregular shapes and is well suited to blow into existing walls and older structures. Loose-fill insulation is commonly packaged in bags that contain 3 to 4 cubic feet.

2. **Flexible, fibrous** insulation is available in either blanket or batt forms. Blankets and batts are manufactured in width (15" and 23") that fits in between normal wall studs, ceiling joists, and floor joists spacing (16" and 24" O.C.). Blanket thickness of 1" to 3 1/2" are most common while

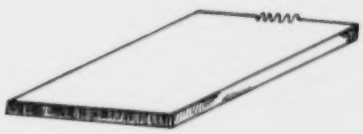
batts can be greater, such as 6", 10", or 12". Blankets are packaged in 30' to 80' long rolls. Batts are cut into 2', 4', or 8' lengths. Blankets and batts have flanges of paper on both edges so that they can be nailed or stapled between wall studs and floor or ceiling joists.





3. **Rigid** insulation is lightweight or low-density pressed boards of wood fiber, cane fiber, mineral wool, cork, glass fiber foamed glass, and foamed plastics. Rigid insulation boards are available from 8 in. square tiles to sheets 4 ft. wide and 10 ft. long. Insulating boards have many uses which include:
   a. Roof and wall sheathing
   b. Subflooring
   c. Sandwich boards that combine roof sheathing, insulation and finished ceiling
   d. Decorative purposes for interior surfaces of walls and ceilings
   e. Perimeter insulation for foundation walls and concrete slab floors

   Polystrene, a foamed plastic, is a recent development that is widely used in masonry work because of its water-resistant quality.



4. **Reflective or metallic** insulation is in a class all its own. To be effective, it depends on its bright reflective surfaces to turn back heat and dead air spaces of 3/4 inches or more in depth so that reflective surface does not touch any other surface. The number of reflective surfaces, not thickness of the material, determines its insulating value. Aluminum-backed gypsum - plaster lath or wallboard and accordion-type foil in conjunction with waterproof paper are common types of reflective or metallic insulation.

BEST COPY AVAILABLE

TRANSMISSION OF HEAT

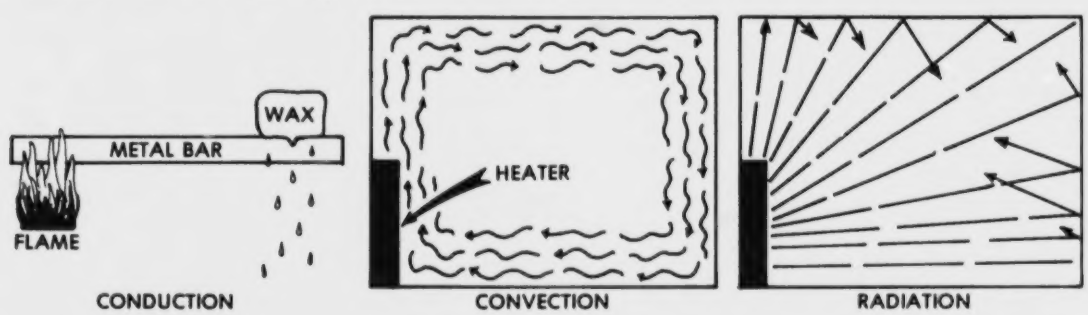
Heat seeks a balance with surrounding areas. When the inside temperature is controlled within a given comfort range there will be some flow of heat; from the inside to the outside in winter and from the outside to the inside during hot summer weather.

Heat is transferred through walls, floors, ceilings, windows and doors by one or a combination of three methods. They are as follows:

1. **Conduction** is the transmission of heat from molecule to molecule within a given material or from direct contact of two materials. Materials such as metals or stone conduct heat more rapidly than wood or fiber products because they are more dense.

2. **Convection** applies to the transfer of heat by another agent, usually air. Air flow is caused because as air is heated it becomes lighter and rises.

3. **Radiation** is heat transmitted by wave motion in about the same manner as light. Heat from the sun is an example of radiant heat. When the sun heat waves come in contact with a colder surface, a part of the energy is absorbed while some may be reflected.



THERMAL INSULATION TERMS

The thermal properties of common building materials and insulation materials are known or can be accurately measured. With a working knowledge of certain terms, the amount of heat transfer can be calculated for any combination of materials.

MATERIAL	THICKNESS	R
Brick Veneer	4 inches	.44
Concrete Block	8 inches	1.11
Hardboard	1/4 inches	.18
Plywood	3/8 inches	.47
Insulation Board	25/32 inches	2.06
Gypsum Sheathing	1/2 inches	.45
Wood	25/32 inches	.98
Gypsum Lath and Plaster	7/8 inches	.41
Mineral Wool Blanket	1 inch	3.70
Plastic (Foamed)	1 inch	5.00
Corkboard	1 inch	3.70
Vermiculite (Loose Fill)	1 inch	2.08
Air Space (Vertical)	3/4 inches of more	.97

BEST COPY AVAILABLE

1. **BTU** is the abbreviation for British Thermal Unit and is the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit.

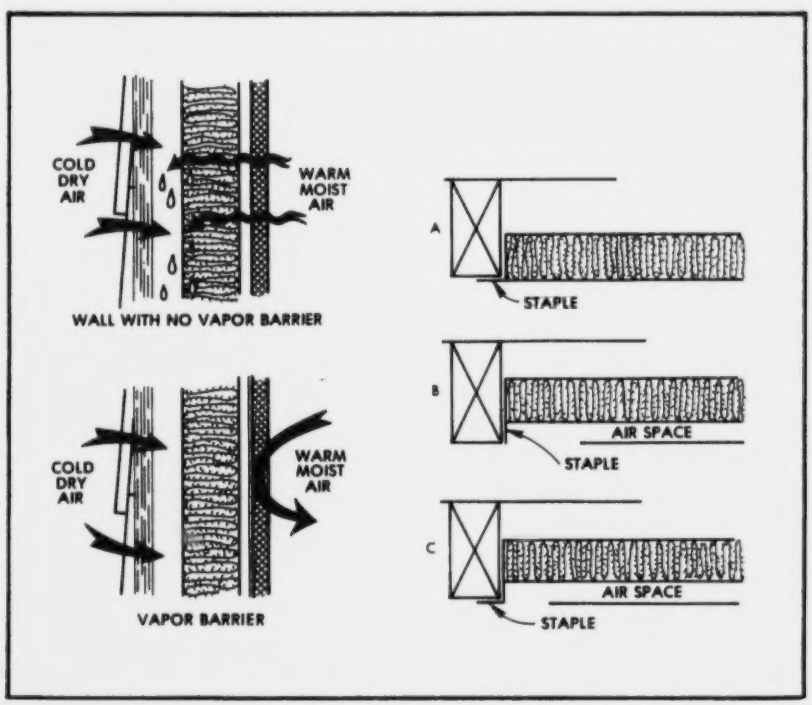
2. **"R"** is the abbreviation for resistance of a material to the transfer of heat. A good insulation material will have a high "R" value.
   Example: A R-19 rating is better than a R-11 rated material.

3. **"U"** is the abbreviation for the number of BTU's per hour that will flow through one square foot of the structure when there is a one-degree difference in temperature between the two sides. The higher the "U" factor of a structure, the more heat will be lost through it; the lower the "U" factor, the less heat loss and the better its insulation properties.

VAPOR BARRIERS

Asphalt-coated paper, aluminum foil and polyethylene films are common material used as vapor barriers. Vapor barriers are used to prevent warm interior water vapor from passing through the insulation and then, under certain atmospheric conditions, condensing on outside exterior walls, ceiling and floor spaces. Excessive moisture can cause exterior paint to peel, stain wall finishes and rotting of wood structural members.

The vapor barrier is installed correctly when it is placed on the warm air side to prevent warm moist vapor from going through the insulation to the cool side and condensing. The manufacture normally provides a flange or tab along the edge used to attach the blanket or batt to wall studs and ceiling or floor joists.



ESTIMATING MATERIALS

When determining the amount of insulation required for the job, figure the area in square feet when using blanket, batt, rigid, or reflective types. The formula for figuring area is:

Area(wall) = Height in feet x length in feet
Area(ceiling & floor) = Width in feet x length in feet
NOTE: Figuring for window and door loss optional.

Example: An exterior wall 8' tall and 20' long would require 160 sq. ft. of insulation material.

Area (sq. ft.) = Height x length or 8' x 20' = 160 sq. ft.

NOTE: Thickness is determined by desired "R" value specified on building plans and limited by the size (depth) of the framing members when installed between them. A 2 x 4 stud will allow a maximum thickness of 3 1/2".

When using loose-fill insulation, the cubic feet of material required must be figured. The formula for figuring cubic feet is: Area(sq. ft.) x thickness in feet.

Example: A ceiling 40' x 50' will require 1000 cu. ft. of blown insulation if filled to a 6" thickness.

W' x L' x T' = cubic feet or 40' x 50' x .5'(6"/12") = 1000 cu. ft.

If the insulation is sold in bags that cover 25 sq. ft. at the cost of $5.50 per bag, the insulation cost for the ceiling would be $220.00.

1000 cu. ft./25 cu. ft./bag = 40 bags x $5.50/bag = $220.00

SAFETY

When working with insulation materials, careful attention should be paid to the safety of the worker. Proper eye and head protection should be worn at all times. Clothing such as a long sleeve cotton shirt that buttons snugly around the neck are highly recommended. Gloves to protect the hands from irritation can also be helpful.

Respirators and filter masks are sometimes recommended. Carefully read the manufacturer's instructions regarding their use with such insulation material.

Remember to always READ and FOLLOW the manufacturer's instructions regarding their product!

ASSIGNMENT SHEET
ON
INSULATION MATERIALS

VIII-A-1(AS)
KEY

SUBJECT: Thermal Insulation/Material Estimations

AIM: To develop the student's ability to calculate the amount of insulation material required and determine the cost.

INTRODUCTORY INFORMATION:

Thermal insulation is sold in many forms or types. Blanket, batt, rigid and reflective insulation is figured on the basis of area (sq. ft.). The thickness is then specified as separate data. The formula for figuring area (sq. ft.) is:

Walls = Height in feet x length in feet
Ceiling or Floors = width in feet x length in feet

Loose-fill insulation is either blown in place or placed by hand and the amount required is figured on the basis of cubic feet. The formula for figuring cubic feet is:
Area (sq. ft.) x thickness(T) in ft. or

$$\text{feet} \times \text{feet(area in sq. ft.)} \times \frac{\text{thickness in inches}}{12}$$

After the amount of insulation has been figured, the cost is determined by multiplying the cost per unit (sq. ft. or cu. ft.) times the total number of units.
Example:
6" batt insulation cost $.23/sq. ft. How much would 160 sq. ft. of insulation cost?
160 sq. ft. x .23/sq. ft. = $36.80

REFERENCES:

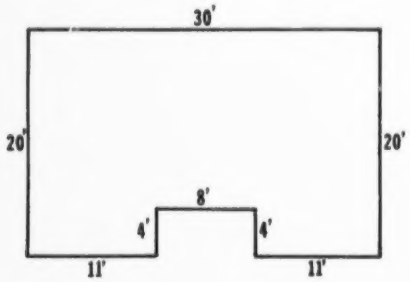
Wagner, Willis H., Modern Carpentry, Unit 13

QUESTIONS OR PROBLEMS:

1. Determine the square feet of insulation in the following:
   a. A wall 8' tall and 60' long — 480 sq. ft.
   b. A floor 20' wide and 40' long — 800 sq. ft.
   c. A ceiling 40' wide and 55' long — 2,200 sq. ft.
   d. Walls of a house 30' x 40' with 8' height — 1,120 sq. ft.

2. Determine the cubic feet of insulation in the following:
   a. A ceiling 30' wide x 50' long x 6" thickness — 900 cu. ft.
   b. A floor 40' wide x 50' long x 3" thickness — 500 cu. ft.
   c. A wall 8' tall x 40' long x 6" thickness — 160 cu. ft.
   d. Walls for house 60' x 90' x 8' height x 4" thickness — 800 cu. ft.

3. Determine the square feet of insulation required in the exterior walls of the following floor plan. 864 sq. ft.



4. A house is 36' x 48' with 8' ceilings and requires 6" insulation in the ceiling and walls. The total cubic feet of blown insulation required for the entire house is: 1,536 cu. ft.

5. A house is 25' x 40' with 8' ceilings. Determine the total square feet of batt insulation required for the walls and ceilings. 2,040 sq. ft.

6. A roll of 6" batt insulation will cover 50 sq. ft. How many rolls of insulation should one buy to insulate a house that requires 3,000 sq. ft. of insulation? 60 rolls

7. The cost of a roll of 3 1/2" batt insulation costs $8.05 per roll. Thirty-five rolls will cost_____? $281.75

8. A bag of insulation will cover 36 sq. ft. at 4" thick. How many bags would be required to insulate a ceiling that has an area of 1,980 sq. ft.? 55 bags

9. What is the total cost of the bag insulation in problem 8 if each bag cost $5.50 per bag? $302.50

10. The insulation job required 36 rolls of batt insulation and 34 bags of insulation. Rolls cost $12.49 and the bags cost $5.55 per bag. The total cost of insulation is: $638.34

INSTRUCTOR'S PLAN VIII-A-1(S)
MANIPULATIVE LESSON

TASK:	Install Thermal Insulation in Walls and Ceiling
AIM:	The student will be able to correctly install insulation in walls and ceiling.
TOOLS AND EQUIPMENT:	Necessary safety equipment, pocket tape, straightedge, pencil, razor blade or hook knife, shears, claw hammer, staple gun, ladder, necessary scaffolds
MATERIALS:	As per details and specification - insulation materials, nails or staples
REFERENCES:	Wagner, Willis H., Modern Carpentry, Unit 14
PREREQUISITE EXPERIENCE OF THE LEARNER:	The student must have successfully completed related lesson and assignment sheet, VIII-A-1(I) and VIII-A-1(AS).
CHECKING STANDARDS:	1. Material selection 2. Spacing of wall studs and ceiling or floor joists 3. Material estimations 4. Selection of tools 5. Maintains safe work habits

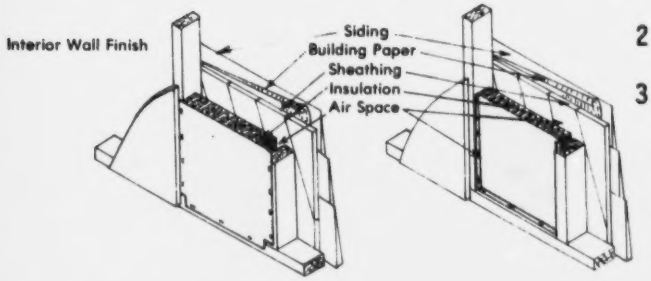
I. PREPARATION (OF THE LEARNER - MOTIVATION)

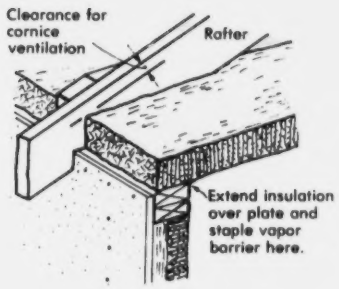
Economical and successful operation of heating and air conditioning systems depends on a well-insulated structure. A thorough insulation job will require that all spaces be filled and vapor barriers positioned correctly. Even the best insulation will not provide its rated resistance to heat flow if the manufacturer's instructions are not followed or if it is torn or otherwise damaged during or after installation.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Select Material	1. As per detail and specification 2. Manufacturer's recommendation 3. Check condition, avoid torn or damaged materials, repair properly
2. Preparation of Materials	1. Determine length (top of sole to bottom of top plate) 2. Mark length on floor if blanket type is used 3. Cut to length plus 2" to 3" longer 4. Form flange on each end for stapling 5. Manufacturer's specification

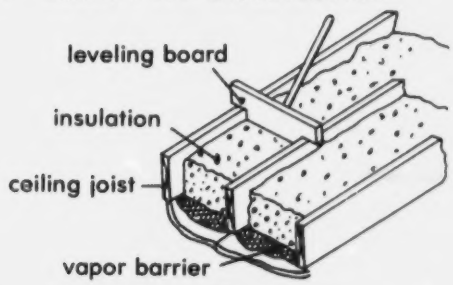
3. Blanket or Batt Installation





1. Place insulation between framing members with vapor barrier to warm side (inside usually)
2. Staple or secure all flanges or tabs flush with inside of framing members
3. Walls
   a. Secure insulation to underside of top plate
   b. Align and staple (no more than 12") down sides, see manufacturer's recommendations
   c. Eliminate gaps or wrinkles
   d. Staple insulation to sole plate last
   e. Fit insulation carefully around plumbing pipes and electrical outlet boxes
4. Ceilings
   a. Extend insulation over top plate
   b. Butt ends snugly together removing all gaps
   c. Bridging - cut material to fit half way in from each side; cover with vapor barrier
   d. Align and staple (no more than 12")
   e. Eliminate gaps and wrinkles

4. Loose-Fill Installation



1. Pour or blow into place
2. Level with straightedge when necessary
3. Install vapor barrier before the ceiling finish is applied

NOTE: Blown-fill insulation work generally is performed by an insulation contractor and should not be attempted by any person unless properly safeguarded against inhalation of particles of insulating materials

5. Rigid Installation

1. Manufacturer's specification should be closely followed for installation
2. Match end-matched material
3. Install sheet vertically, generally less waste and air gaps

6. Reflective Installation

1. Staple as regular fibrous material over or between framing members
2. Air space in vertical section (wall) should be 3/4" or more
3. Air space in ceiling and floors is 1 1/2" or more
4. Review manufacturer's recommendations

7. Safety

1. Observe all safety rules and regulations
2. Wear proper safety apparel
3. Think safety at all times

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates proper procedure for installing thermal insulating material.
Instructor passes out job and task sheets.
Students practice job and tasks under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance test!

Students install thermal insulation according to blueprints and specifications.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

Correct application and installation of insulation is very important for the proper operation of heating and cooling systems. Careful attention should be paid to manufacturer's recommendations and specifications.

Vapor barriers should always be installed to the warm side to prevent moisture accumulation. Flange or tabs are provided for ease of installation.

All cracks, voids, or spaces must be filled. Work of the highest quality is required to do a thorough job.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 13

THE NEXT LESSON IS: VIII-A-2(S), "Installing Acoustical Insulation"

JOB SHEET VIII-A-1(J)
ON
THERMAL INSULATION

NAME OF JOB:	Installation of Thermal Insulation
DRAWINGS:	Blueprint floor plan, elevations and details
MATERIALS:	As per specifications and details - thermal insulation materials, staples, nails
TOOLS AND EQUIPMENT:	Necessary safety equipment, pocket tape, straightedge, pencil, razor blade or hook knife, shears, claw hammer, staple gun, ladder, necessary scaffolding
GENERAL INSTRUCTIONS:	Study the plans and specifications. Determine insulation material type and quantities best suited for job. Determine and cut to common lengths where required. Attach or place insulation over or between framing members. Vapor barrier should be installed to warm side. Staple or secure flange or tab flush with inside of framing member. Eliminate all gaps and wrinkles. Observe all safety rules and regulations. Wear the proper safety apparel for the job and think safety at all times.
PROCEDURES AND/OR TASKS:	VIII-A-1(TS) Install Blanket or Batt Insulation VIII-A-1a(TS) Install Rigid Insulation

TASK SHEET VIII-A-1(TS)

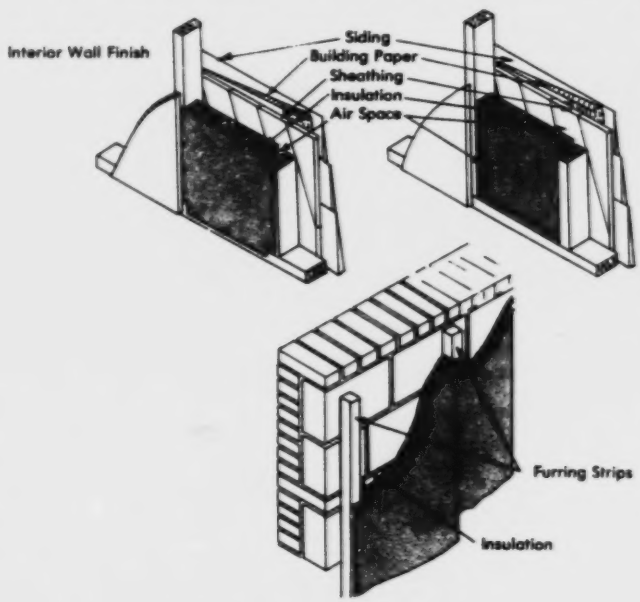
TASK: Install Blanket or Batt Insulation

JOB: Installation of Thermal Insulation

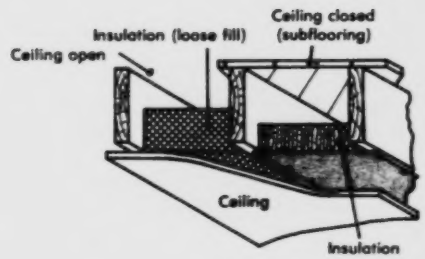
TRADE: Building Trades

TOOLS AND MATERIALS: Insulation per blueprints and specification, pencil, straightedge, staple gun, shears, razor blade or hook knife, ladder, necessary scaffolding, tape, proper safety equipment.

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Select Material	1. Size (width, length, thickness) as per specifications and details 2. Vapor barrier requirements
3. Layout and Cut	1. Blanket insulation a. Measure space to insulate b. Mark required length on rough floor c. Unroll blanket on floor to align with marks d. Cut the required number of insulation 2" to 3" longer than measured length, squarely 2. Batt insulation - select long lengths such as 8' which is a common ceiling height
4. Installation of Blanket or Batt 	1. Walls a. Remove or pull loose a small portion of insulation from backing to form a flange for attaching, both ends b. Place insulation between studs with vapor barrier to inside of the room c. Staple all flanges or tabs flush with inside edge of stud and according to manufacturer's recommendations d. Staple top end to top plate e. Staple down along the side of stud aligning material carefully to remove all wrinkles f. Fit insulation around pipes or electrical fixtures; cut where necessary g. If two pieces are used, butt ends together and overlap vapor barrier at least 1" h. Staple insulation to sole plate

STEPS	KEY POINTS



i. Continue until all walls have been insulated

2. Ceilings
   a. Select proper ladder or erect necessary scaffolds
   b. Start at one side and place insulation between joists with vapor barrier down
   c. Extend one end of insulation out over the outside wall plate, staple vapor barrier to sole plate
   d. Smooth and align material with flanges or tabs flush with bottom of joists and wrinkles removed
   e. Staple flanges or tabs on the inside of joist
   f. Continue positioning material between joists and butt snugly together
   g. Overlap vapor barriers at least 1"
   h. If bridging is present, cut material to fit half way in from each side
   i. Continue until entire ceiling is insulated

TASK: Install Rigid Insulation

JOB: Installation of Thermal Insulation

TRADE: Building Trades

TOOLS AND MATERIALS: Insulation per building blueprints and specifications, razor blade or hook knife, ladder or scaffolding, staple gun, claw hammer, nails, proper safety equipment, crosscut saw (electric or hand), chalk line, square, level, pocket tape

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Select Materials	1. Size (width, length, thickness) as per specifications and details 2. Matched ends - free of nicks and missing pieces 3. Nails or staple - size and type specified by manufacturer
3. Installation of Material	1. Place material vertically or per manufacturer's specifications 2. Bottom of panel should be flush with bottom of sole plate 3. Edge flush to the end of wall or plywood corner bracing 4. Other edge should be centered on stud spacing, plumb 5. Attach per manufacturer's specification for nails or staples 6. Continue to cover entire wall area in same manner 7. Remove (cut) materials from rough openings and save to use later 8. Continue until entire building is insulated

INSTRUCTOR'S PLAN VIII-A-2(I)
INFORMATIONAL LESSON

SUBJECT: Acoustical Insulation

AIM: The student will be able to install acoustical ceiling tiles and/or a suspended acoustical ceiling system according to blueprints and specification while following good building practices and procedures.

TEACHING AIDS: Information Sheet VIII-A-1(IS)

MATERIALS: Samples of acoustical materials; tile and board forms, furring strips, suspended ceiling channel, tile cements

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 13
Watson, D.A., Construction Materials and Processes, Unit 18

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must exhibit a sincere interest in building trades and meet the requirements of the Texas Education Agency and local school district.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

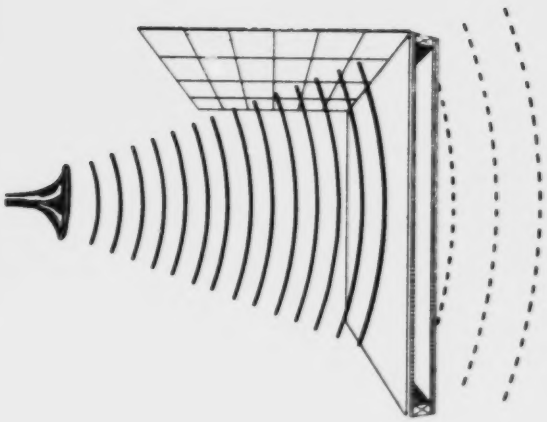
Today's living is noisy. Noise, unwanted sound, is a by-product of today's modern society. Modern day conveniences such as television, stereo, vacuum cleaners, food processors, washer and driers, heating and cooling equipment, and power tools make life easier and more pleasant, but at the same time they create noise. Noise is unpleasant, reduces human efficiency, and can cause fatigue. To effectively and economically control sound, careful attention must be paid to construction practices, installation methods, and selection of materials.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING TOPICS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Nature of Sound Passout: VIII-A-2(IS)	1. Produced by vibrations transmitted in air 2. Travels through air approximately (1) one mile per 5 seconds 3. Analyzed by ear a. Vibrations strike eardrum b. Multiplied by series of bones in inner ear c. Transmitted by nerve endings that convey impluses to the brain
B. Measurement of Sound	1. Loudness perceived by the ear depends on intensity and frequency 2. Frequency is the rate at which sound energized air molecules vibrate a. Cycles per second (Hz) b. 16Hz lowest for human ear c. 20,000 Hz highest

3. Intensity is measured in terms of apparent loudness
   a. Decibel (dB) is unit of measurement of smallest change in intensity
   b. Threshold of hearing - 0dB
   c. Threshold of pain - 130dB

C. Reduction of Sound



1. Acoustical materials have the property of absorbing 50% or more ofthe sound waves striking their surfaces
2. Amount of sound absorbed depends on pores in material and frequency
   a. Size
   b. Number
   c. Depth
3. Sound energy is dissipated as heat
   a. Friction is caused by air particles set in motion by sound waves that move in and out pores
   b. Heat is transmitted through material or reflected back into the room
4. Noise-reduction coefficient (NRC) - percentage of sound absorbed by a material
   a. NRC of 0 - no sound absorbed
   b. NRC of 1 - absorbs all sounds reaching the material
5. Flanking is the bypassing of sound around acoustical material
   a. Open windows, doors
   b. Air conditioning or heating devices
   c. Medicine cabinet

D. Acoustical Materials

(Show examples)

1. Common materials are:
   a. Cane fiber
   b. Asbestos fiber - health hazard, no longer used in public buildings
   c. Mineral fiber
   d. Glass fiber
2. Cellulose-fiber tiles
   a. Sugar cane fiber
   b. Oldest, cheapest type of acoustical material
   c. Perforated to give sound-absorbing qualities
   d. Not fireproof
   e. Easy to paint
3. Mineral-fiber tile
   a. Mineral wool from blast furnace slag
   b. Fissured or perforated for sound-absorbing qualities
   c. Class A fire rating - incombustible
   d. Paint with extreme care, non-bridging paint

4. Perforated metal tile
   a. Metal pan filled with acoustical material
   b. Baked-on enamel finish
   c. Initial cost relatively high
   d. Economical from standpoint of durability and maintenance
   e. High reflective surfaces
5. Acoustical plaster
   a. Should be sprayed on
   b. Two coat application
6. Prefabricated forms
   a. Tiles, 12" x 12" common
   b. Boards

E. Other Qualities for Construction Purposes
1. Insulating qualities
2. Light reflection
3. Flame resistance
4. Moisture resistance
5. Ease of installation
6. Cost

F. Installation of Acoustical Materials
1. Cementing (adhesive application)
   a. Approximately 50% of tiles installed
   b. Least expensive, most common method
   c. Requires smooth, solid base
2. Nailing or stapling
   a. For ceiling not level or true enough for cementing
   b. Requires furring strips across ceiling joist
3. Mechanical suspension systems
   a. Concealed-suspension metal not visible
   b. Semiexposed-only main runners are exposed
   c. Exposed-all supporting structures are exposed

G. Estimating Materials (Work samples)
1. Figured on the area (square feet)
2. Formula for figuring area
   Length(ft.) x width(ft.) = square feet

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

Field Trip: Local commercial building
Make necessary arrangement
Prior to trip, discuss with the student; purpose, schedule, conduct, safety, what to look for, parental permission
After trip, review with students - class discussion, oral questions

Guest speaker: Local insulation contractor

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

Simple Recall

1. Sound is produced by _____ transmitted in air.	vibrations
2. The rate at which sound energized air molecules vibrate is called sound _____.	frequency
3. Hz stands for _____.	frequency
4. Sound _____ is measured in terms of apparent loudness.	intensity
5. Decibel in the unit of measurement for the smallest change in intensity and its abbreviation is _____.	dB
6. The amount of sound a material absorbs depends on the size, depth and number of _____ in the material.	pores
7. A NRC of _____ means that all sounds reaching an acoustical material are absorbed.	1
8. The bypassing of sound around acoustical materials is called _____.	flanking
9. The oldest and generally the cheapest type of acoustical tile is _____-fiber.	cellulose
10. Cementing, nailing or stapling, and mechanical suspension are all forms of _____ of acoustical tiles or boards.	installation

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

Noise is unwanted sound and is a by-product of modern times in our nation. Modern conveniences have made life more comfortable and easier, but inside noises have increased. Increased numbers of automobiles, freeways, and air travel have added to outside noises.

Sound is vibrations transmitted in air and analyzed by the ear. Frequency or cycles per second (Hz) of vibrations is the rate at which sound energized molecules vibrate. Decibel is the unit used to indicate change in intensity. Intensity is measured in terms of apparent loudness.

Acoustical materials have the properties to absorb 50% or more of the sound waves striking their surfaces. Their ability to absorb sound depends on the size, number, and depth of pores in the material and frequency. The percentage of sound absorbed is expressed as the noise-reduction coefficient (NRC). Flanking is the bypassing of sound around acoustical material.

Cane, asbestos, mineral and glass fiber are common materials used in the fabrication of acoustical materials. Other qualities desirable in acoustical

materials, from construction standpoint, are insulation qualities, light reflection, flame and moisture resistance, maintenance, ease of installation and cost.

Acoustical materials are generally installed in one of three methods:

1. Cementing or adhesive application - most common and least expensive method. Requires a smooth, solid base.
2. Nailing or stapling - requires furring strips. Done when the ceiling is not level or true enough for cementing.
3. Mechanical suspension systems - suited very well for commercial applications where duct work and plumbing are above room.

Quantity of acoustical materials is figured for the area. For calculating area in square feet use the formula:

Length(ft.) x Width(ft.) = Square Feet(Area)

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 13

THE NEXT LESSON IS: VIII-B-1(I) "Interior Wall Finishes"

INFORMATION SHEET VIII-A-2(IS)
ON
INSULATION MATERIALS

SUBJECT: Acoustical Insulation

INTRODUCTORY
INFORMATION:

Technical changes and advancements have made life more comfortable in many ways. On the other hand, technology has created more noise encountered in everyday life. Noise (unwanted sound) is not desirable, it reduces workers efficiency and can cause undue fatigue.

Dissipation of sound is made possible by fibrous and/or porous sound-absorbing materials. Sound waves move in and out of the pores causing friction. The sound energy is dissipated as heat and transmitted through the material or reflected back into the room.

To obtain effective and economical sound control, the student of building trades must have a working knowledge of acoustical insulation materials: types, amounts, cost, installation, and other aspects that apply to its selection and use. Careful attention must be given to the quality of work if unwanted sound is to be controlled.

GENERAL INFORMATION:

NATURE OF SOUND

Sound is produced by vibrations (sound waves) transmitted in air at an approximate speed of one (1) mile ever five (5) seconds. The frequency and intensity of the vibrations determine the loudness of the sound. Noise, or unwanted sound, has reached such magnitude that it demand careful attention in the planning and construction of homes and commercial buildings today.

MEASUREMENT OF SOUND

The loudness of sound perceived by the human ear depends on two major measurements of sound, intensity (dB) and frequency (Hz) of the vibration.

Sound frequency or the cycles per second (Hz) is the rate at which sound energized air molecules (sound waves) vibrate. These sound waves travel through air at approximately one mile per five seconds. Hearing by the human ear is limited to a low frequency of 16 Hz and a high of 20,000 Hz. Most common sound cover a wide range of frequencies.

SOUND	RANGE (Hz)
Piano	30-4,000
Violin	196-2,100
Womans' voice	196-1,050
Mans' voice	82-500

Acoustical materials are commonly rated by their ability to absorb or dissipate

sound at a particular frequency. The sound-absorption qualities of a material are usually tested at 125, 250, 500, 1,000, 2,000 and 4,000 Hz.

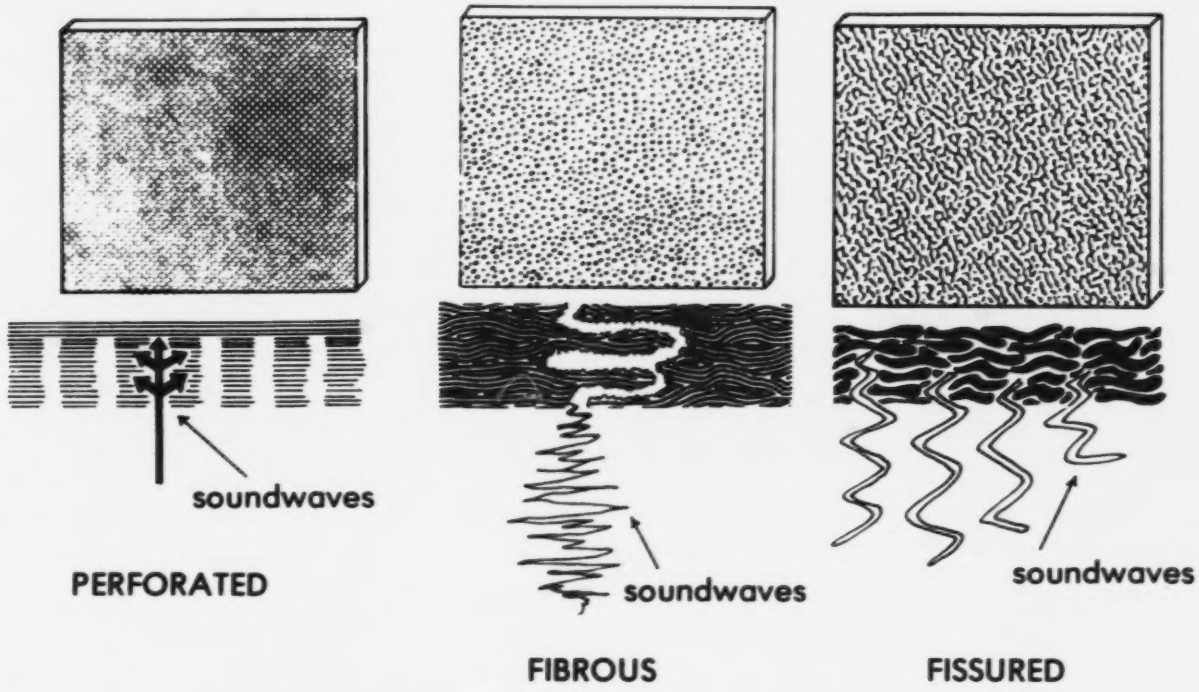
Sound intensity is measured in terms of apparent loudness. The unit of measurement for the smallest change is intensity is the decibel (dB). The human ear responds to a wide range of sound intensity. The threshold of hearing (silence) is 0 dB and terminates at 130 dB which is the threshold of pain. The following chart gives the approximate sound levels of a few common sounds encountered daily.

SOUND (NOISE)	DECIBELS (dB)	SENSATION
Jet Plane	110-130	Painful
Thunder Passing Train Jack Hammer	100	Deafening
Noisy Factory or Plant Rock and Roll Music (live) Truck (unmuffled) Average Stereo Level	80-90	Very Loud
Print Shop Typical Street Noise Average Radio and TV Level Average Factory or Plant Average Office	60-70	Loud
Typical Office Noisy Home Average Conversation Quite Radio	50-60	Moderate
Private Office Quite Household Bedroom Empty Theater Average Auditorium Soft Conversation Leaves Rustling Whisper Sound Proof Room	30-50	Quite Very Faint
Threshold of Audibility	0	Silence

REDUCTION OF SOUND

Common acoustical or sound-absorbing materials have the ability to absorb 50% or more of the sound waves striking their surfaces. This cushioning effect counteracts undesirable noises. It makes living and working conditions more pleasant, improves human efficiency and reduces undue fatigue.

The effectiveness of a material to absorb sound depends on the size, depth, and number of pores in the material. Frequency of the sound is also a factor. Sound waves move in and out of these pores causing friction and the sound energy is dissipated as heat. The heat is transmitted through the acoustical or reflected back into the room.



The percentage of sound energy absorbed by a material is expresses as its noise-reduction coefficient (NRC). Any material that absorbs all sound reaching it is given an NRC of 1. If the material absorbs no sound, it is given an NRC of 0.

Flanking is the bypassing of sound energy around sound-absorbing materials. The flanking paths can be open windows, doors, cooling or heating ducts, cracks, medicine cabinets, air-returns and through floors. Good construction practices and selection of acoustical materials are a must to eliminate flanking.

ACOUSTICAL MATERIALS

There are numerous types of acoustical materials available to the builder. Common material are cane, asbestos, mineral and glass fibers. Prefabricated tiles and boards are the most common forms manufactured and used by builders. They range in size from a 12" x 12" tile to boards 4' x 16'.

Cellulose-fiber tiles are the oldest and generally the cheapest types of acoustical tile. They are usually made from sugar cane fiber. The tiles are perforated to give it sound-absorbing qualities. They are not fireproof, but their rate of burning is low. Cane-fiber tile usually have a factory-applied paint finish.

Mineral-fiber tiles are made mostly of mineral wool which is produced from blast furnace slag in the United States. After the slag is remelted, and reaches the desired temperature, it is blown into wool by a jet of high pressure steam or compressed air. It can also be spun into filaments by the action of a high speed rotating disk. The finished product may be fissured (small voids) or perforated (holes) to develop its sound-absorbing qualities. Mineral fiber tiles are used where building codes require a tile that is incombustible in places such as public assembly and exit areas. Extreme care must be used when painting fissured tiles to prevent bridging of paint and thus destroying the acoustical characteristics of the material.

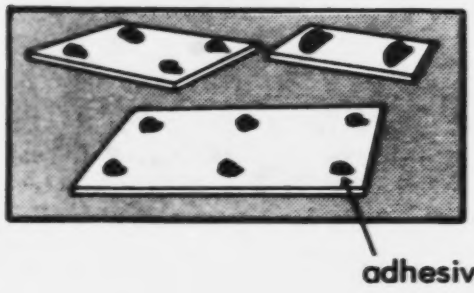
Perforated metal tile consist of a perforated metal pan, aluminum or light gauge steel, filled with a pad of some acoustical material. The initial cost is relatively high, but is economical to use from the standpoint of durability and maintenance. Since it is usually finished with a baked-on enamel paint, it can be cleaned easily and does not require repainting. The hard enamel finish provides high reflective values which are beneficial in area such as large offices and classrooms.

Acoustical plasters are made of cementitious or binding materials such as gypsum, lime, and certain types of clay. Vermiculite, perlite, and pumice are commonly used as aggregates. The acoustical plaster material is usually sprayed over standard gypsum base coat. The first coat is 1/4" to 3/8" thick and allowed to dry overnight. The second coat (finish) is applied to bring the total thickness to a minimum of 1/2".

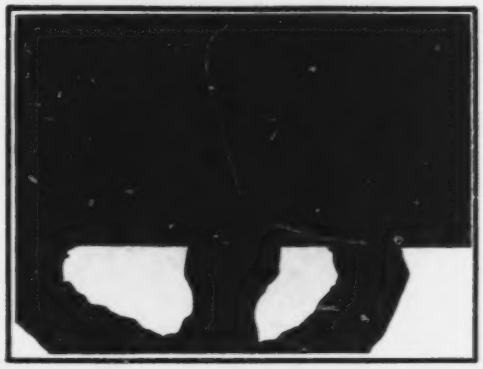
INSTALLATION OF ACOUSTICAL MATERIALS

As with most building materials, careful attention must be given to construction practices and manufacturer's recommendations when installing acoustical materials. Most acoustical tiles or boards are installed as follows:

1. **Cementing** is the most common and least expensive method of installing acoustical tiles. About 50% of all acoustical is applied by cementing. Cementing requires a smooth, solid, and flat base. Acoustical tiles for cementing are butt edged (without flange). The adhesive cement used should be as per the specifications of the manufacturer of the tile to assure proper bonding to the base material.



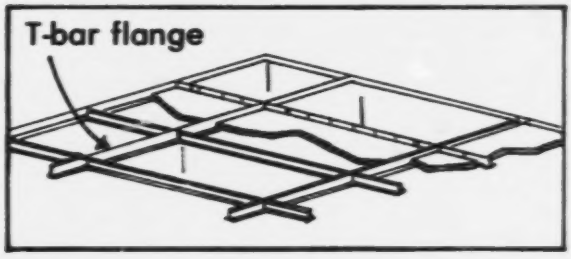
2. **Nailing or stapling** the acoustical tiles in position is required on ceilings not level or true enough for cementing application. A furring strip is first attached to the ceiling and shimmed or wedged out to even or level the surface. A wide-flanged tile can be attached to the furring strips. Stapling has proven to be a more economical method of installing the tile than nailing.



3. **Mechanical suspension systems** are used where suspended ceilings are recommended to cover structural beams, plumbing pipes, electrical wiring and lower high ceilings in older structures. Acoustical panels used in suspended ceilings are commonly made from ground cork or glass fibers. They are ideal for use in indoor swimming pools, commercial kitchens, or any other place where humidity is a problem.

   Suspended ceiling panels are installed with three different systems. They are:

   a. In **concealed systems** none of the suspension metal is visible. The major disadvantage is the difficulty of access to the space above.
   b. In **semi-exposed systems** the main runners are exposed. They run parallel and can be spaced as far apart as 4 ft. on center.
   c. In **exposed systems** all of the suspension members are visible and the bottom flange of the suspension member carries the weight of the acoustical boards. This system allows access to the space above at almost any location and any time.



ESTIMATING MATERIALS

When determining the amount of acoustical insulation for the job, figure the area in square feet for the ceiling. The formula for figuring area is:

Width in feet x Length in feet = Area in square feet

Example: A ceiling 20' wide and 24' long would require 480 sq. ft. of acoustical tile.

Width x Length or 20' x 24' = 480 sq. ft. (Area)

Materials (supporting) for suspended ceilings should be as per manufacturer's specifications.

SAFETY

Careful attention should be paid to safety when handling insulation materials. Proper safety apparel and eye protection should be worn at all times by the student.

If respirators or filter masks are required, follow the manufacturer's instructions for their use.

Remember to always READ and FOLLOW the manufacturer's instructions regarding their product or equipment!

INSTRUCTOR'S PLAN
MANIPULATIVE LESSON

VIII-A-2(S)

TASK: Install Acoustical Ceiling Insulation

AIM: The student will be able to correctly install acoustical ceiling insulation.

TOOLS OR EQUIPMENT: Necessary safety equipment, chalkline, razor blade or hook knife, fiberboard cutter, adhesive, nails, staples, putty knife, claw hammer, staple gun, straightedge, pencil, ladder or necessary scaffolds, level, pocket tape

MATERIALS: As per details and specifications - acoustical insulation, nails or staples or adhesive, suspension materials

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 14

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must have successfully completed related lesson VIII-A-2(I).

CHECKING STANDARDS: Teacher's check on quality/procedure of students work.
Example:
1. Selection of tools
2. Installation procedure/quality of work
3. Maintains safe work habits
4. Material selection
5. Material estimations

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Careful attention must be given to construction practices, installation methods, and selection of materials to effectively and economically control and reduce sound. Properly selected and installed acoustical insulation requires that the manufacturer's instructions be followed closely. Uncon-trolled sound can be very annoying, unpleasant, reduce human efficiency and cause undue fatigue.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Check Plans, Specifications	1. Specifications for material a. Size b. Quantity c. Cost 2. Manufacturer's recommendations 3. Method of installation 4. Safe storage of material
2. Cementation of Acoustical Material	
A. Preparation	1. Check squareness of ceiling 2. Check levelness of ceiling

3. Determine soundness of ceiling
4. Locate center of room
5. Snap chalkline perpendicular (across) of ceiling joists
6. Measure room and determine the size of border tiles

NOTE: Tiles should be 6" or larger

B. Tile Section/Preparation

1. Use butt edge tile

NOTE: Condition tiles to atmosphere conditions 24 hours prior to installation

2. Cut border tiles to uniform size for ends and sides of the ceiling

CAUTION: Extreme care should be used when working with sharp tools such as knives or cutters

C. Installation

1. Snap a chalkline equal to the width of tile from the wall for the first row
2. Apply half-dollar size dabs of adhesive at each corner of border tile
3. Place first ceiling tile in the corner and press in place, align with chalkline
4. Complete the row and entire ceiling

NOTE: Begin each new row of tile with a trimmed border tile

5. Place molding around perimeter of wall to cover cut edges of border tile

NOTE: Paint molding before installing to avoid brush marks on the ceiling tile

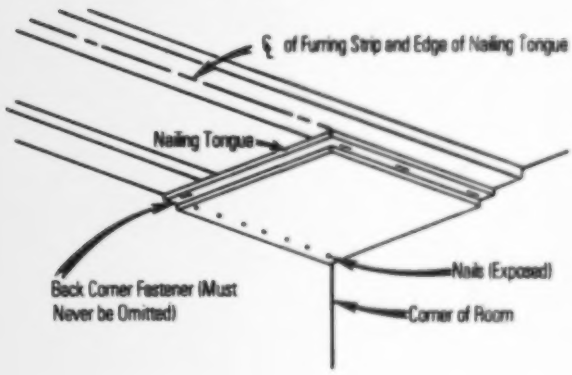
3. Nailing or Stapling Acoustical Insulation

A. Preparation of Furring Strips, Tiles

1. Locate center of room and snap chalkline perpendicular (across) to ceiling joists
2. Determine spacing and location for furring strips
   a. If border rows is 6" or larger, center furring strip over chalkline and nail
   b. If border row is less than 6", center and nail furring strip 6" on either side of chalkline center
3. Nail furring strips with 8d nails or one that penetrates at least 1" into ceiling joists
4. Level furring strips by shimming low spots with small wedges between strips and joists
5. Trim border tile to correct size

NOTE: Trim from finished, not flanged side with sharp knife or fiberboard cutter

B. Installation


℄ of Furring Strip and Edge of Nailing Tongue
Nailing Tongue
Nails (Exposed)
Back Corner Fastener (Must Never be Omitted)
Corner of Room

1. Snap a chalkline along the first furring strip away from wall
2. Position first tile in corner with uncut or flanged edge on the chalkline
3. Nail or staple cut edge by face nailing
4. Secure flange edge, stapling preferred
5. Slide tongue of next tile into groove of 1st tile and secure flanges to furring strip

NOTE: Stapling is preferred

CAUTION: Watch the position of ones' fingers

6. Complete entire ceiling

NOTE: Start each new row with a border tile

7. Place molding around perimeter of wall

NOTE: Paint molding before installing to avoid brush marks on the ceiling tile

4. Suspended Acoustical Ceiling

A. Preparation

1. Determine height of suspended ceiling from floor

NOTE: Ceiling should be 3" below any obstruction or 6" below existing fluorescent lights

2. Snap a chalkline on the walls around the perimeter of the room

B. Installation of Support Frame, Tiles/Boards

1. Secure wall molding to walls using chalkline as guide
2. Layout and stretch a number of strings from one wall molding to opposite wall molding to serve as guides for leveling
3. Attach main tee hanger wires to ceiling joists as per manufacturer's instructions

NOTE: Hanger wire should be 12 or 14 gage wire

4. Cut main tees to length of room minus 1/8"

NOTE: Border tiles or boards should be of equal size at the end and sides of walls if whole units are not possible

5. Place end of tee on wall molding and attach hanger wires in perforations of main tee

NOTE: If splicing is required, follow manufacturer's instructions and place hanger wires on each side of the splice

6. Level tees by crimping hanger wires, using stretch string as guides for levelness
7. Cut cross tees 1/8" less than required length
8. Install cross tees by inserting end connectors into appropriate slots of main tees
9. Complete suspension system

10. Position acoustical panels by carefully moving panel through framework and lowering panel to rest on flanges of main and cross tees

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrate correct procedure for installing acoustical insulation.
Instructor: Passout job and task sheets.
Student: Practice job and tasks under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY

Performance Test!

Student installs acoustical insulation as per building plans and specifications.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

For effective and economical control or reduction of unwanted sound, proper construction practices, correct installation, and selection of the right material must be adhered to. The manufacturer's recommendations and instruction should be followed with a minimum of variations. There can be no substitute for quality of work.

Acoustical insulation tiles or boards can be installed by cementing, nailing or stapling, and suspension systems.

Cementing - requires smooth, solid and flat surfaces.

Nailing or stapling - used where ceiling is unlevel, requires furring strips

Suspension systems - used to lower high ceilings, accessibility of duct work, electrical wires, plumbing

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 14

THE NEXT LESSON IS: VIII-B-1(S) "Installing Gypsum Wallboard"

JOB SHEET VIII-A-2(J)
ON
ACOUSTICAL INSULATION

NAME OF JOB:	Installation of Acoustical Insulation
DRAWINGS:	Builder's plan and details
MATERIALS:	As per specifications and details - acoustical insulation materials, adhesive, nails or staples, suspension framing materials
TOOLS AND EQUIPMENT:	Necessary safety equipment, chalkline, level, razor blade or hook knife, fiberboard cutter, adhesive, nails, staples, putty knife, claw hammer, staple gun, straightedge, pencil, ladder or necessary scaffolding, pocket tape
GENERAL INSTRUCTIONS:	Study building plans and specifications. Calculate quantities and types of material best suited for job. Note such items as soundness and levelness of ceiling; obstructions like duct work, electrical wire, and plumbing; installation methods.
PROCEDURES AND/OR TASKS:	VIII-A-2(TS) Cementation of Acoustical Tile VIII-A-2a(TS) Nailing or Stapling Acoustical Tile VIII-A-2b(TS) Suspended Acoustical Ceiling

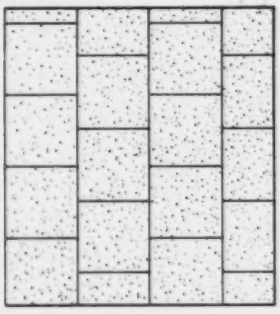
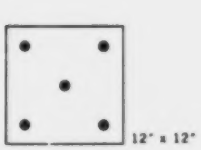
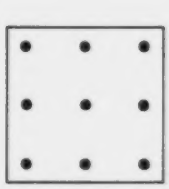
TASK: Cementation of Acoustical Tile

JOB: Installation of Acoustical Insulation

TRADE: Building Trades

TOOLS AND MATERIALS: Insulation tile per building plans and specifications, pencil razor blade or hook knife, fiberboard cutter, putty, adhesive, straightedge, chalkline, ladder or necessary scaffolding, pocket tape, claw hammer, nails

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Select Materials	1. Size (width, length, thickness) as per specifications and details 2. Butt edge tile not flanged 3. Adhesive designed for specific tile
3. Preparation 	1. Check squareness and levelness of ceiling 2. Determine soundness of ceiling and make necessary repairs and preparation for existing ceiling 3. Locate center of room 4. Snap chalkline perpendicular (across) of ceiling joists 5. Measure room and determine the size of border tiles NOTE: Tiles should be 6" or larger 6. Cut border tiles to uniform size for ends and sides of the ceiling
4. Installation of Tile  	1. Snap a chalkline equal to the width of tile from the wall for first row 2. Apply half-dollar size dabs of adhesive at each corner of border tile 3. Place first ceiling tile in the corner and press in place, aligned with chalkline 4. Complete the row and entire ceiling NOTE: Begin each new row of tile with a trimmed border tile 5. Place molding around perimeter of wall to cover cut edges of border tile NOTE: Paint molding before installing to avoid brush marks on the ceiling tile
CHECK POINT:	Open cartons and condition tiles to atmospheric conditions 24 hours prior to installation

TASK: Nailing or Stapling Acoustical Tile

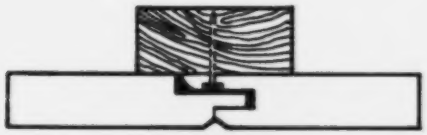
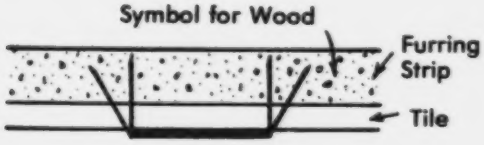
JOB: Installation of Acoustical Insulation

TRADE: Building Trades

TOOLS AND MATERIALS: Insulation tile per building plans and specifications, pencil razor blade or hook knife, fiberboard cutter, claw hammer, staple gun, nails, staples, straightedge, chalkline, ladder or necessary scaffolding, pocket tape

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications.	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Select Materials	1. Size (width, length, thickness) as per specifications and details 2. Flanged edged tile 3. Nails or staples as per manufacturer of tile 4. #2 common 1" x 4" or better 5. Nails for furring strips
3. Preparation of Furring Strips/ Tiles	1. Locate center of room and snap chalkline perpendicular (across) of ceiling joists 2. Determine spacing and location for furring strips a. If measured border row is 6" or larger, center furring strip over chalkline and nail b. If measured border row is less than 6", center and nail furring strip 6" on either side of center chalkline 3. Nail furring strips with 8d nail or one that penetrates at least 1" into ceiling joist 4. Level furring strips by shimming low spots with small wedges between strips and joists NOTE: Use string or straightedge to determine levelness 5. Trim or cut border tile to correct size NOTE: Trim from finished, not flanged side with sharp knife or fiberboard cutter
4. Installation of Tile	1. Snap a chalkline along the first furring strip away from wall 2. Position first tile in corner with uncut or flanged edge on the chalkline

STEPS	KEY POINTS
 Nailing Flanges	3. Nail or staple cut edge by face nailing NOTE: Staple with one staple driven directly over the other 4. Secure flange edge, stapling preferred CAUTION: Watch the position of one's fingers 5. Slide tongue on next tile into groove of 1st tile and secure flange to furring strip NOTE: Stapling is preferred 6. Complete entire ceiling NOTE: Start each new row with a border tile 7. Place molding around perimeter of wall NOTE: Paint molding prior to installing, the prevents brush marks on the ceiling tile
	
CHECK POINT:	Open cartons and condition tiles to atmospheric conditions 24 hours prior to installation

TASK: Suspended Acoustical Ceiling

JOB: Installation of Acoustical Insulation

TRADE: Building Trades

TOOLS AND MATERIALS: Insulation tile or boards per building plan specifications, pencil, razor blade or hook knife, fiberboard cutter, claw hammer, nails or screws, straightedge, chalkline, pocket tape, ladder or necessary scaffolding

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Selection of Materials	1. Size (width, length, thickness) as per specification on building plans 2. Moisture resistance qualities 3. Suspension framing a. Main tee supports b. Cross tee supports c. Wall mounting 4. Wire hanger material, #12 or 14 gage
3. Preparation of Materials	1. Determine height of suspended ceiling from floor NOTE: Ceiling should be 3" below and obstruction or 6" below existing fluorescent lights and located above highest window or door casing and finish trim 2. Snap a chalkline on the walls around the perimeter of the room
4. Installation of Support Frame, Tiles/Boards	1. Secure wall molding to walls using chalkline as a guide 2. Layout and stretch a number of strings from one wall molding to opposite wall molding to serve as guides for leveling main tees 3. Attach main tee hanger wires to ceiling joists as per manufacturer's instructions NOTE: Hanger wire should be #12 or 14 gage wire 4. Cut main tees to length of room minus 1/8" NOTE: Border tiles or boards should be of equal size at the end and sides of walls if whole units are not possible 5. Place end of tee on wall molding and attach hanger wires in perforations of main tee

STEPS	KEY POINTS

NOTE: If splicing is required, follow manufacturer's recommendations

6. Level tees by crimping hanger wires, using stretch string as guides for levelness
7. Cut cross tees 1/8" less than required length
8. Install cross tees by inserting end connectors into appropriate slot of main tees
9. Complete suspension system
10. Position acoustical panels by carefully moving panel through framework and lowering panel to rest on flanges of main and cross tees

INSTRUCTOR'S PLAN VIII-B-1(I)
INFORMATIONAL LESSON

SUBJECT: Drywall Construction

AIM: The student will be able to install and finish gypsum wallboard as per the builder's plans and specifications while performing sound construction practices and procedures.

TEACHING AIDS: Information Sheet VIII-B-1(IS), chalkboard/chalk, film (Shaping the Future with Gypsum Wallboard)

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 14

PREREQUISITE EXPERIENCE OF THE LEARNER: The student(s) must have successfully completed previous lessons in Major Block VIII. The student must also exhibit a sincere interest in learning the building trades while meeting the requirements of the Texas Education Agency and local school district.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Gypsum wallboard, commonly called "sheetrock", is a sheet of gypsum (hydrous calcium sulfate) that has been surfaced with a specially treated paper or other sheet materials. The use of gypsum wallboard in today's construction has steadily increased and has virtually replaced plaster as a means of interior finish.

Gypsum wallboard construction is commonly referred to as drywall construction in texts and on the job sites because of the absence of water that was mixed with a plaster material for interior wall finish. Some of the major reasons for using gypsum wallboard are: fire-resistant, crack-resistant, time saving over plaster, economical to use, and easily positioned.

PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING TOPICS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Composition of Gypsum Wallboard Passout: VIII-B-1(IS)	1. Noncombustible core of hydrous calcium sulfate (mineral) 2. Outer surfaces, top and bottom of sheet, 9-ply treated paper a. Bottom - gray lining paper b. Top - smooth manila
B. Manufacturing Process (Show Film)	1. Calcining - extraction of water from mineral 2. Crushed powder left is often called plaster of paris 3. Ingredients are added for drying and bonding agents 4. Mixed into a thick slurry for casting 5. Slurry cast into sheet 6. Treated paper placed on top and bottom of gypsum core 7. Standard edge shapes

a. Tapered - most commonly used for ease of joint concealment
b. Beveled - commonly used for pre-decorated
c. Round
d. Square
e. T & G (tongue and groove)

C. Standard Sizes

1. Thickness - 1/4" through 1" in 1/8" graduations
2. Width - 24" or 48" (most popular)
3. Lengths - 8', 10', 12', 14', 16'

D. Classification of Wallboard

(Show Examples)

1. Regular - edges usually tapered
2. Pre-decorated - factory applied decorative finish
   a. Edges can be concealed by batten or moldings
   b. Beveled - effect known as shadowline
   c. Secured by adhesive bond or matching prefinished nails
3. Insulating
   a. Back bonded with aluminum foil
   b. Foil back acts as vapor barrier and thermal insulator
4. Fire-resistant - glass fibers and specially formulated additives mixed with gypsum
5. Water-resistant
   a. Gypsum core, asphaltic adhesives, and chemically treated paper
   b. High moisture areas - kitchens, baths, or utility rooms

E. Advantages of Drywall Construction

1. Fire-resistant
2. Crack-resistant
3. Economical to use
4. Easy to position
5. Variety of finishes

F. Installation of Gypsum Wallboard

1. Measurements
   a. Carefully taken from exact location where wallboard will be installed
   b. Make two measurements - checks plumbness and squareness
2. Right angles (horizontal) to framing members
   a. Length of sheets are perpendicular (across) to studs or ceiling joists
   b. Results in fewer joints
   c. Stronger construction
   d. Support 3/8" thickness on maximum 16" O.C.

e. Support 1/2" or greater on maximum 24" O.C.

3. Parallel (vertical) to framing member - must be located on stud
   a. Support 3/8" thickness on maximum 16" O.C., not recommended for ceiling
   b. Support 1/2" or greater on maximum 24" O.C. for walls
   c. Support 1/2" or greater on maximum 16" O.C. for ceilings
4. Cutting - across width or length
   a. Score face of sheet
   b. Use knife with straightedge
   c. Place supports close to scored line
   d. Press downward on overhang (waste) and snap core
   e. Cut paper back with razor blade knife
   f. Irregular shapes and curves can be cut with keyhole saw or electric sabre saw
5. Placement
   a. Ceiling first
   b. Sidewalls last
6. Single and double layer construction
7. Reinforcement of corners
   a. Exterior - metal corner bead
   b. Interior - reinforcing tape

G. Fasteners for Gypsum Wallboard (Consult Manufacturer's Recommendations)

1. Nailing of gypsum wallboard
   a. Cement-coated or annular ring types
   b. Single-nailing system - spaced not less than 3/8" from edges, spaced not more than 8" O.C. in the center of sheet
   c. Double nailing system - spaced not less than 3/8" from edge, 1st spaced 12" O.C., 2nd 2" from first
   d. Drive nail straight and true
   e. Slight dimple, careful not to break paper face
2. Stapling - used to fasten first-ply of a two-ply system
   a. 16 gage, flattened, galvanized
   b. Minimum penetration 5/8"
   c. 7/16" crown
   d. Spaced 3/8" from edge
   e. Spaced 7" O.C. for center of sheet
3. Screws - self-drilling, self-tapping
   a. Various lengths and gages
   b. Spaced 16" O.C. where framing members are 16" O.C.
   c. Spaced 12" O.C. where framing members are 24" O.C.
4. Adhesive
   a. Largely eliminates nails or screws

b. Produces sturdier walls
c. Zig-zag form of bead where two pieces of wallboard join
d. Continuous bead center of all stud and joists where wallboards do not join
e. Bead width - 1/4" to 3/8"
f. Insure full contact of wallboard until adhesive develops required bonding strength

5. Adhesive and nailing
   a. Reduces nailing approximately 50%
   b. Concealment of nailheads reduced
   c. Nails on 24" centers

H. Joint and Fastener Concealment

1. Tapes generally made of high-quality paper
2. Joint and fasteners require three coats of joint compound
3. Allow to dry thoroughly between each coat

I. Surface Texturing

1. Roller application - coarseness of texture determined by nap length of roller
2. Spray application - most common method, time and cost savings
3. Material available in premixed or mixed-on-site packages
4. May be troweled smooth or given texture finished
5. Painting and texturing can be combined into one operation

J. Estimating Materials

1. Figured on the area (square feet) and thickness per specification
2. Formula for figuring area:
   Length' x Width' = Area (sq. ft.)

Example:
25' x 30' = 750 sq. ft.

3. Walls
   a. Add total perimeter of building
   b. Multiply by ceiling height
   c. Deduct area (sq. ft.) for doors and windows, optional

Example:
Perimeter = 20' + 40' + 20' + 40'
= 120'
Area = 120' x 8'(ceiling height)
= 960 sq. ft.
Net Area = 960 - sq. ft. for windows and doors
= X number of sq. ft.

4. Ceiling - measure width and length of room

Example:
Area (sq. ft.) = 20'(w) x 40'(l)
= 800 sq. ft.

K. Related Safety

1. Apparel
   a. Long sleeve shirt that buttons around the neck
   b. Respirator or filter mask
   c. Safety glasses
   d. Hard hat
2. Tools and equipment, proper use of:
   a. Claw hammer and nails
   b. Staple gun (power or hand)
   c. Razor blade or hook knife
   d. Saw horses
   e. Floor jack

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES PARTICIPATING IN DISCUSSION.)

1. Have students identify various types of gypsum wallboard.
2. Have students discuss advantages, fasteners, and installation of gypsum wallboard.
3. Work example problems estimating gypsum wallboard with students.
4. Have students complete assignment sheet VIII-B-1(AS).

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

Simple Recall

1. Gypsum wallboard construction is commonly called _____ construction. — Drywall
2. Gypsum wallboard has a _____ core of hydrous calcium sulfate. — Noncombustible
3. _____ is the term for extraction of water from hydrous calcium sulfate. — Calcining
4. The _____ edge provides a depression which allows a smooth and even surface after joints are concealed. — Tapered
5. Standard thickness for gypsum wallboard ranges from 1/4" to 1" in _____ graduations. — 1/8"
6. Gypsum wallboard that has a factory applied decorative finish is called _____. — Pre-decorated
7. _____ gypsum wallboard is recommended for high moisture areas such as baths and washrooms. — Water-resistant
8. If gypsum wallboard is installed at right angles to framing members, the board is _____ to studs or ceiling joists. — Perpendicular

9. Nails are set correctly in gypsum wallboard when there is a slight dimple and the nail head does not break the _____ face. Paper

10. _____ coats of joint compound are required for the concealment of joints and fasteners. Three

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

Gypsum wallboard or drywall construction has steadily increased and has all but replaced the use of plaster for interior wall finishes. Major reasons for using gypsum wallboard are: fire-resistant, time saving over plaster, economical to use, and ease of installation.

Gypsum wallboard is hydrous calcium sulfate sandwiched between specially treated paper. Regular, pre-decorated, insulating, fire-resistant, and water-resistant are the five basic types of gypsum wallboard manufactured. The standard edge shapes are tapered, beveled, round, square, and tongue and groove.

Standard gypsum wallboard sizes are widths of 2 and 4 foot and 8, 10, 12, 14, and 16 foot lengths. Wallboard varies in thickness from 1/4" to 1" in graduations of 1/8".

Application of gypsum wallboard at right angles (long edge across the support member) is preferred because it results in fewer joints and generally stronger construction. If long edge is installed parallel to support member, joints must be located on the framing member. Thickness of wallboard to use is determined by the spacing (on-center) of the stud or ceiling joists.

Example: 3/8" thick wallboard can be used on wall studs spaced 16" O.C. but not on 24" O.C.

Nails, screws, adhesive, or combination of these are the common fasteners used for drywall construction. Consult manufacturer's recommendation on the use of fasteners and their application. Care should be taken not to break the paper face.

When joints and fasteners are to be concealed, three coats of joint compound are required. Each coat should be allowed to dry thoroughly before next coat is applied. Reinforcement tape should be used on all joints except external corners which require metal corner beads.

Drywall material for a particular job is figured by the square foot. To calculate square feet, use this formula:

Area (square feet) = Length in feet x Width in feet

The handling and installation of gypsum wallboard requires careful attention be given to the proper safety apparel and using correctly, the right tool for the job.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Chapter 14

THE NEXT LESSON IS: VIII-B-2(I) "Wall Panels"

INFORMATION SHEET VIII-B-1(IS)
ON
INTERIOR WALL FINISHES

SUBJECT: Drywall Construction

INTRODUCTORY INFORMATION:

Gypsum wallboard construction, or drywall construction as it is commonly referred to, includes fastening gypsum wallboard (sheetrock) to wood or metal framing members, concealing joints and fasteners, and finishing the surface. Drywall construction has virtually replaced plaster as a means of interior wall finish because of it's time saving factor.

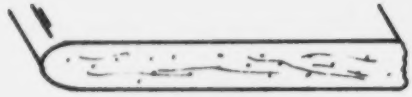
Gypsum wallboard is manufactured in a variety of types, thicknesses, edge shapes, and surfaces. The student(s) of building trades will probably be required, at some point, to work with drywall construction. The student(s) needs to have a good working knowledge of drywall construction: types, quantities, cost, installation, and other aspects that apply to its selection and use.

GENERAL INFORMATION:

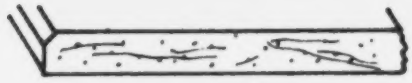
COMPOSITION OF GYPSUM WALLBOARD

Gypsum wallboard is a sheet of gypsum that has a fire-resistant core. Gypsum is produced from hydrous calcium sulfate by a process called calcining process. Water is extracted and crushed powder plus ingredients for drying and bonding are mixed into a thick slurry. The slurry is cast into sheets and sandwiched between treated paper. Standard edge shapes are tapered, beveled, round, square, and tongue and groove.

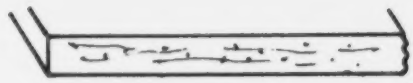
TAPERED EDGE



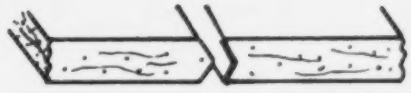
ROUND EDGE



BEVELED EDGE



SQUARE EDGE



T&G

STANDARD SIZES

Gypsum wallboard is available in various thickness from 1/4" to 1" thick in 1/8" graduations. Width of wallboards are either 24" or 48" with the 48" being the most popular. Common lengths are 8, 10, 12, 14, and 16 feet. Select material sizes as specified by local building codes.

CLASSIFICATION (TYPES) OF WALLBOARDS

Drywall construction materials produced are classified as one of the five following:

1. **Regular** wallboard is most commonly used in drywall construction. The edges are generally tapered. When tapered edges are butted together, they form a shallow channel. This channel allows the use of reinforcing tape and joint compound that provides a smooth and even surface at the joint after the finishing process.

2. **Pre-decorated** wallboard as a factory-applied decorative finish. The wallboard length is generally installed vertically or parallel with the framing members. The joints can be concealed with batten or molding. Edges of the wallboard can be beveled and not covered at all. This is known as the shadowline effect. The pre-decorated wallboard is fastened to the framing members by the use of an adhesive or machine prefinished nails. Moldings are also available for trimming edges and joints.

3. **Insulating** wallboard is basically regular wallboard with a back bonded with aluminum foil. The foil backing acts as a vapor barrier and thermal insulator.

4. **Fire-resistant** wallboard is regular wallboard with an altered core containing glass fiber and specially formulated additives mixed with the gypsum.

5. **Water-resistant** wallboard is made with gypsum core plus asphaltic adhesives and chemically treated paper. It is generally used in high moisture areas such as baths, utility room, and kitchens.

ADVANTAGES OF WALLBOARD

The use of gypsum wallboard has increased in drywall construction for several reasons. The wallboard is fire-resistant because the gypsum core does not burn. It is crack-resistant because extremes in temperature and humidity do not effect panel size. Wallboard is economical to use, easily positioned and can have a variety of finishes such as paint, textures, wallpaper and fabrics.

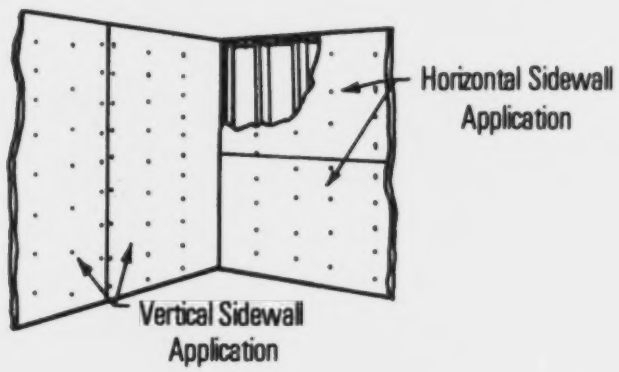
However, drywall construction requires that the framing member be straight and true to avoid uneven wall and ceiling surfaces. Gypsum wallboard should not be used in areas of excessive moisture unless water-resistant backing board is used. Also, the wallboard should not be used in a plaster base.

INSTALLATION OF GYPSUM WALLBOARD

All measurements should be taken from the exact location where the wallboard will be positioned. Two measurements should be made, one on each side of the panel.

This procedure will help eliminate or minimize error and reveal openings and framework that are not plumb.

Gypsum wallboard can be installed vertically or horizontally. When the wallboard is installed horizontally, the long edge (length) is at right angles (perpendicular) to the framing members. This results in fewer joints, less cuts, joints at a more convenient heights, easier handling and stronger construction in sidewalls. If the wallboard is installed vertically, the long edge (length) is parallel with the framing members. Joints which run vertically must be located and fastened at studs or ceiling joists.



Along with the position of the wallboard on the supporting member, the thickness of the sheet that can be used is determined by the spacing (on center) of the framing members. Support a 3/8" thickness wallboard on a maximum of 16 O.C. spacing and don't use it at all if the wallboard is installed parallel to framing members in the ceiling. Follow the manufac-turer's recommendations in regards to spacing of framing members and parallel or perpendicular installation of the wallboard. Ceilings are installed first and sidewalls last.

GYPSUM DRYWALL (Single Layer)

Installed long direction of sheet	*Minimum thickness (inches)*	*Maximum spacing of supports (inches o.c.)*	
		Walls	Ceiling
Parallel to framing members	3/8	16	-----
	1/2	24	16
	5/8	24	16
Right angles to framing members	3/8	16	16
	1/2	16 24	24
	5/8	24	24

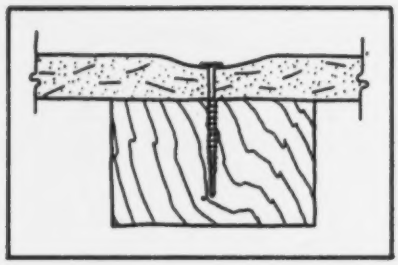
Straight cuts are made across the width or length of the gypsum wallboard on the face side of the board. With a knife and straightedge, score the paper face. Support the board near the scored line and, pressing downward on the overhang, snap the board. Cut the paper back with a razor blade knife. Rough cuts can be smoothed with a file or coarse sandpaper and sanding block. Odd shapes, curves, and holes can be cut with a keyhole saw and an electric sabre saw.

Most gypsum wallboard in drywall construction is applied in a single-ply (layer) application using 1/2" or 5/8" thick material. Two-ply or double layer wallboard applications provide a stronger wall, improves fire protection and adds acoustical insulation qualities. An adhesive is used to laminate the two layers together. Careful attention should be paid to manufacturer's recommendations for selection and application of the adhesive and the construction of the two-ply system.

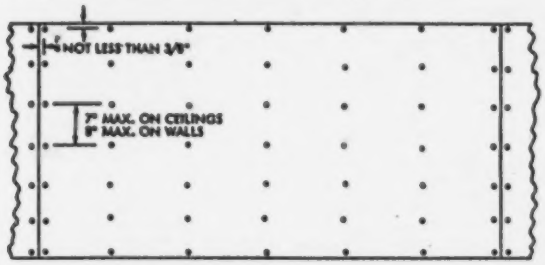
FASTENERS FOR GYPSUM WALLBOARD

Regardless of the fasteners or combination of fasteners selected, care should be taken to use them as the manufacturer recommends. Fasteners for gypsum wallboard are:

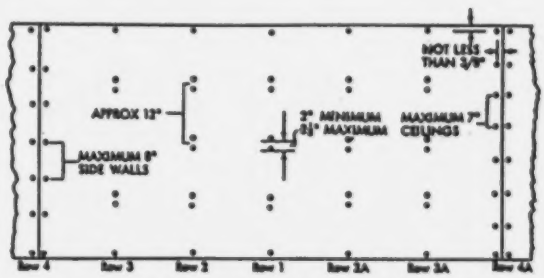
1. Nails used are of two basic types, cement-coated and the annular ring. Regardless of which nail is used, it should comply with performance standards set by the Gypsum Drywall Contractors International Gypsum Association. Care should be used in driving and setting of the nail. Drive nails straight and set the nail head in a slight depression. Be very careful not to break the face paper or crack the core of the wallboard.



All wallboard must be drawn tightly against the framing member to prevent any movement of the board on the nail shank. Two systems used in nailing are the single and double nailing system.

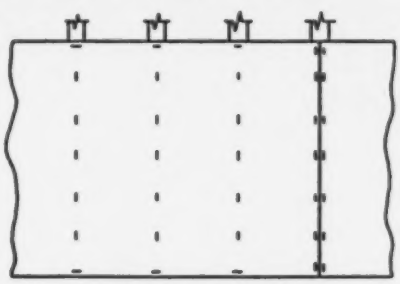


SINGLE-NAILING SYSTEM



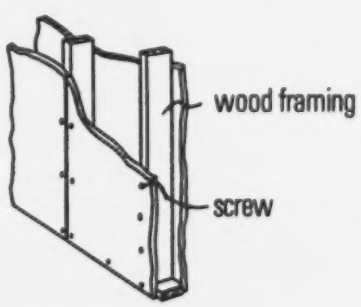
DOUBLE-NAILING SYSTEM

2. Staples are often used to fasten the first ply of a two ply wallboard system. The staple should be 16 gage, flattened and galvanized, and have a minimum of 5/8" into the framing member with a 7/16" crown. The crown should run parallel to the edge when the outside edge of the wallboard is attached and parallel to the framing members in the center of the board.

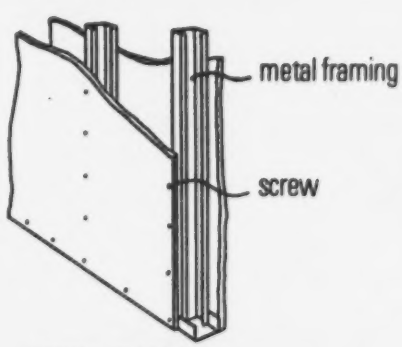


STAPLE APPLICATION

3. Screws provide a firm, tight and more secure attachment of wallboard than nails in a wood frame and can also be used for attachment in metal framing. Special self-drilling, self-tapping screws are used for metal-framed wallboard systems. Screws designed to secure wallboard to either wood or metal framing are available in various lengths and gages. The screwhead must be driven slightly below the paper face surface of the board and should not cut the paper or fracture the gypsum core.



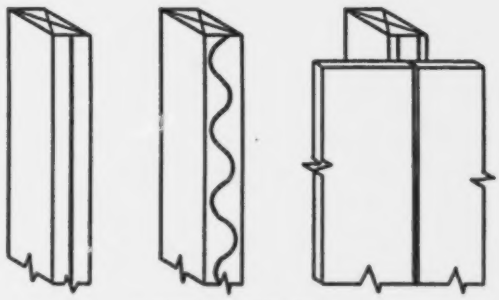
WOOD FRAMING



METAL FRAMING

Screws are generally spaced on 16" centers when the framing members are 16" O.C. and spaced 12" O.C. when framing members are 24" on center

4. **Adhesives** can be used for either single-ply or double-ply applications. The use of adhesives can eliminate the use of nails or when used in conjunction with nails, nailing is reduced approximately 50 percent. The concealment of nail heads is also reduced. The use of adhesive also produces a sturdier unit. A continuous adhesive bead of 1/4" to 3/8" wide should be applied to the center of all framing members or zig-zagged where joints meet to bond the wallboard. Temporary nailing or bracing is used to insure full contact of the wallboard until the adhesive develops the required bonding strength.

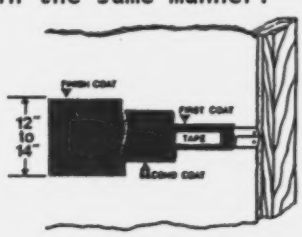


ADHESIVE APPLICATION

JOINT AND FASTENERS CONCEALMENT

To provide a smooth, even surface, all joints and fasteners must be properly concealed, but joints can be concealed by applying a bedding coat of joint compound into the depression formed by the tapered edges of the two boards butted together. A reinforcing tape is then centered and pressed into the joint compound and smoothed out to avoid wrinkling or buckling. This is done with a 5" or 6" flexible knife and drawn along the joint with enough pressure to remove excessive compound and leave a skim coat. After the first layer or coat is completely dry, apply a second coat and feather (spread) the joint compound beyond the edges of the first coat. The third coat is applied after the second coat has completely dried and feathered out about 2" beyond the second coat using a 10" plastering trowel. If necessary and after final coat has completely dried, sand lightly with 220 or 320 grit sandpaper. Internal corners are concealed in the same manner as the butt joints. Exterior corners are reinforced with a metal corner bead and finished as butt and internal corner joints.

Concealment of fasteners require three coats of joint compound. Before the first coat is applied, make sure that all heads are slightly below the surface of the wallboard. Fastener heads are usually covered as each coat of joint compound is applied to joints and finished in the same manner.



TAPERED JOINT

64

SURFACE TEXTURING

A multi-purpose joint compound and texturing mixture is available at most businesses that sell construction material. It can be bought in pre-mixed containers or dry sacked and mixed on the job site. Spray application of texturing is the most common method of applying textured surfaces because of time and labor cost savings. Texture can also be done with a paint or texture roller application. The coarseness of the stripped (textured) surface is dependent upon roller selected and pressure applied. Regardless of application method, always read and follow the manufacturer's recommendations on the use of their product.

ESTIMATING MATERIALS

When determining the number of sheets of gypsum wallboard to finish a home or building, the total square feet of surface area must be determined. The formula for figuring area is:

Area(wall) = Height in feet x length in feet
Area(ceiling) = Width in feet x length in feet
Note: Figuring for window and door loss is optional.

Example: An interior wall 8' tall and 16' long would require 128 sq. ft. of gypsum wallboard or 2 sheets 4' x 16'.

Area(sq. ft.) = Height in feet x Length in feet or 8' x 16' = 128 sq. ft.
Number of sheets = 128 sq. ft. / 64 sq. ft. per sheet = 2 sheets

Using the formula for area, the amount of wallboard for a ceiling can also be figured.

Example: A ceiling 16' x 20' will require 320 sq. ft. of gypsum wallboard or 5 sheets 4' x 16'.

Area(sq. ft.) = Width in feet x Length in feet or 16' x 20' = 320 sq. ft.
Number of sheets = 320 sq. ft. / 64 sq. ft. per sheet = 5 sheets

SAFETY

When working gypsum wallboard, careful attention should be paid to the safety of the worker. Proper eye and head protection should be worn at all times. Clothing such as a long sleeve cotton shirt that buttons snugly around the neck are strongly recommended. Care should be taken to lift properly as the sheets of gypsum wallboard are very heavy.

Respirators and filter masks are sometimes recommended. Carefully read the manufacturer's instructions regarding their operation and use.

Remember to always <u>READ</u> and <u>FOLLOW</u> the manufacturer's instructions regarding their product!

ASSIGNMENT SHEET
ON
INTERIOR WALL FINISHES

VIII-B-1(AS)
KEY

SUBJECT: Gypsum Wallboard/Material Estimations

AIM: To develop the student's ability to calculate the amount and cost of gypsum wallboard for drywall construction.

INTRODUCTORY INFORMATION:

Gypsum wallboard is commonly sold in 4' x 8', 4' x 10', 4' x 12',4' x 14', or 4' x 16' sheets. The thickness is specified by the builder's plans with 1/2" and 5/8" being the most common thicknesses used. To determine the amount of gypsum wallboard to order for a job requires figuring area in square feet. The formula for figuring area (sq. ft.) is:

Walls = Height in feet x Length in feet
Ceilings = Width in feet x Length in feet

After the amount of gypsum wallboard has been figured, the cost is determined by multiplying the cost per square foot times the total number of square feet or cost per sheet multiplied by the total number of sheets.

Example: 1/2" thick 4' x 8' gypsum wallboard cost $3.29 per sheet. How much would 20, 4' x 8' sheets cost?

20 sheets x $3.29/sheet = $65.80

5/8" thick, 4' x 8' gypsum wallboard cost $.13/sq. ft. How much would a 4' x 8' sheet cost?

$.13/sq. ft. x 32 sq. ft./sheet = $4.16 per sheet

REFERENCES:

Wagner, Willis H., Modern Carpentry, Unit 14

QUESTIONS OR PROBLEMS:

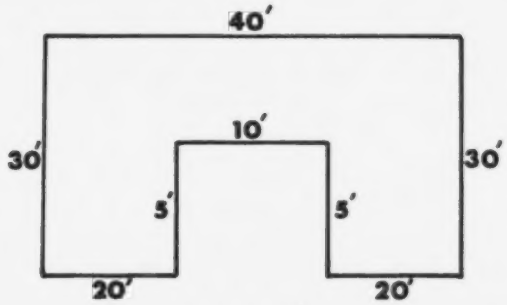
1. Determine the square feet of gypsum wallboard in the following:

   a. A wall 8' tall and 30' long — 240 sq. ft.

   b. A ceiling 20' wide and 25' long — 500 sq. ft.

   c. Walls of a house 25' x 30' with 8' height — 880 sq. ft.

2. Determine the square feet of gypsum wallboard required in the interior walls of the following plan. 1,280 sq. ft.



3. A house is 30' x 55' with 8' ceilings. Determine the total square feet of gypsum wallboard required for the walls and ceiling. 3,010 sq. ft.

4. If 4' x 8' sheets of gypsum wallboard are used for the house in problem 3, how many sheets will have to be purchased? 95

5. If gypsum wallboard, 1/2" thick, costs $3.29 per sheet, how much is the total cost of the material in problem 4? $312.55

INSTRUCTOR'S PLAN VIII-B-1(S)
MANIPULATIVE LESSON

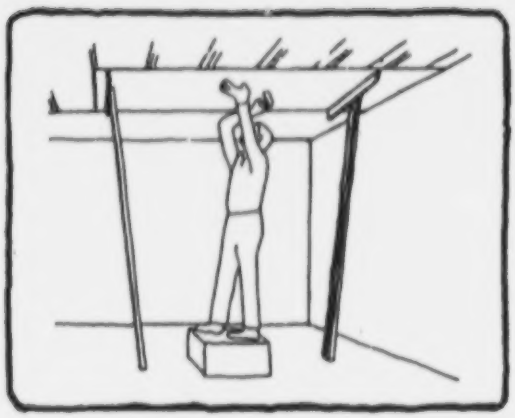
TASK:	Install Gypsum Wallboard
AIM:	The student will be able to correctly install gypsum wallboard for ceilings and interior walls.
TOOLS AND EQUIPMENT:	Necessary safety equipment, pocket tape, straightedge, pencil, razor blade or hook knife, claw hammer, keyhole saw, tin snips, assortment of joint-finishing knives, pan for joint compound, spray gun, texture roller and 2 gallon paint pan, 2" paint brush, sawhorses
MATERIALS:	As per details and specifications - gypsum wallboard, joint compound, reinforcing tape, corner bead, drywall nails.
REFERENCES:	Wagner, Willis H., Modern Carpentry, Unit 14
PREREQUISITE EXPERIENCE OF THE LEARNER:	The student(s) must have successfully completed related lesson and assignment sheet, VIII-B-1(I), VIII-B-1(AS).
CHECKING STANDARDS:	Teacher's check on quality/procedures of students work. Example: 1. Material selection 2. Installation procedure/quality of work 3. Materials estimations 4. Selection of tools 5. Maintain safe work habits

I. PREPARATION (OF THE LEARNER - MOTIVATION)

To obtain smooth interior surfaces with gypsum wallboard, care should be taken in the planning, installing, and concealing all joints and fasteners. The manufacturer's instructions should be followed closely to insure the proper use, selection of materials and fasteners and correct application of gypsum wallboard.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Select Materials	1. As per building plan, estimations 2. Check condition, return damaged materials
2. Preparation of Materials	1. Store properly and protect from moisture 2. Cut to lengths as required 3. Mark locations of electrical boxes, plumbing, etc.
3. Installing Gypsum Wallboard to Ceilings	1. Check room corners for squareness at top plates



2. Measure exact location where wallboard will be installed
3. Layout and cut wallboard so that uncut ends will center on ceiling joists

NOTE: Uncut ends have the tapered edges which aid in concealment of joint

4. When adhesive is used or recommended, apply to bottoms of joists to be covered as per manufacturer's recommendations
5. Position wallboard into place; end against top plate, side against adjacent top plate

NOTE: Start in one corner of room and install wallboard panels perpendicular to the ceiling joist

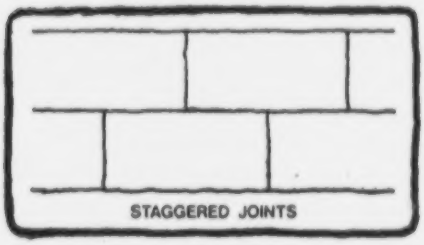
6. If working alone, wedge T-brace between floor and panel to support panel while nailing
7. Secure wallboard to ceiling joists with appropriate fastener. Space nails 7" apart and at least 3/8" from ends and edges

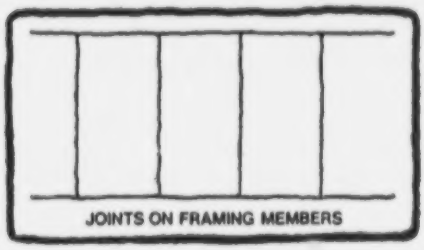
NOTE: Place fasteners at the center of wallboard and work out

8. Continue installing gypsum wallboard until entire ceiling is covered

NOTE: Border sheets may have to be cut to finish run. Always place cut edge against top plates

4. Installing Gypsum Wallboard on Interior Walls





1. Check corner for squareness and plumbness
2. Measure exact location where wallboard will be installed
3. Layout and cut wallboard so that uncut end will center on wall stud
4. When adhesive is used or recommended, apply to faces of studs to be covered as per manufacturer's recommendations
5. For horizontal application, apply top panel first and in the corner, cut edges to the corner, fit ends and edges closely, stagger end joints
6. Use vertical application when ceiling height is over 8'-2"

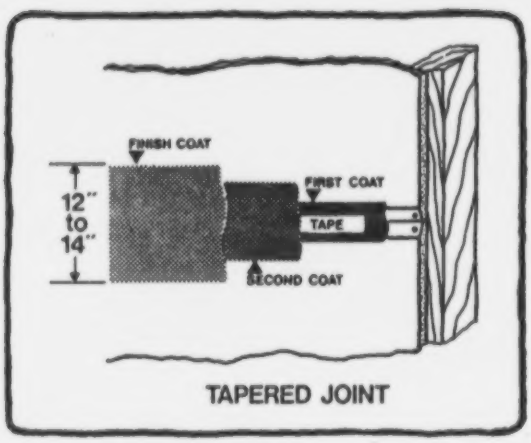
NOTE: Be sure to position all ends or edges of panels over and centered on framing members

7. Secure wallboard to studs with appropriate fasteners using proper technique, space nails 8" apart and at least 3/8" from ends and edges
8. Cut to length and install metal corner bead for all outside corners, space nails 5" apart

9. Continue installation until wall is complete
10. Check ceiling and walls for loose fasteners, replace or drive tighter as per situation
11. If fastener has punctured face paper, place an additional fastener 1 1/2" from the fracture and remove faulty fastener
12. Cut out for electrical switch and outlet boxes using keyhole saw

5. Concealment of Joints and Fasteners

A. Taped Joints

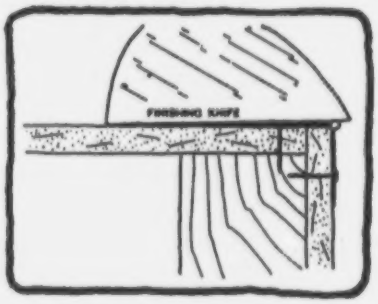


TAPERED JOINT

1. Check and make certain all fasteners are properly set
2. Spread a bedding coat of joint compound into depression formed by joining tapered edges using a 4"-6" joint knife
3. Center reinforcing tape over the joint and firmly press it into joint compound with joint finishing knife. Press hard enough to remove excessive compound and produce a smooth, wrinkle free seam
4. Allow joint to dry 24 hours
5. Apply second coat, extending (feathering) it a few inches beyond edges of tape
6. Allow second coat to dry 24 hours
7. Apply finish coat with 10" joint finishing knife, feathering the edges about 1 1/2" beyond the edges of second coat
8. After finish coat has dried, sand lightly with fine sandpaper if required

NOTE: Fill dimples or depressions for fasteners with three coats of joint compound in conjunction with the joints

B. Outside Corners



1. Lay a sufficient amount of joint compound onto the flanges of the corner bead
2. Level compound with joint finishing knife and extend it onto the face of the wallboard a minimum of 4"
3. Allow to dry 24 hours
4. Apply second coat, feather compound onto the face of the wallboard 1 1/2"-2" beyond the first coat
5. Allow to dry and sand lightly with fine sandpaper if required

C. Inside Corners

1. Using a 4" joint knife or special corner knife, apply joint compound and spread out about 1 1/2" on each side of corner
2. Cut joint tape the exact length of corner

3. Fold tape in the center lengthwise and press it firmly into the corner
4. Use just enough pressure and remove excessive joint compound
5. Allow to dry 24 hours
6. Apply second coat and feather out beyond first coat
7. Allow to dry 24 hours

6. Surface Texturing

1. Prepare the surface prior to application of texturing as recommended by manufacturer of texture material
2. Prepare texture material
   a. Powder - mix according to instructions on package
   b. Pre-mix - stir and blend mixture prior to use and according to instructions
3. Using texture roller or spray gun, apply texture material
   a. Roller - 1/2", 3/8" or 3/4" nap, light pressure for coarse texture, heavy pressure for fine texture
   b. Spray gun - manufacturer's recommendation for application
4. Allow material to set or dry slightly, doesn't have to be completely dry, and apply second coat where required

7. Safety

1. Observe all safety rules and regulations
2. Wear proper safety apparel
3. Think safety at all times

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION

Instructor: Demonstrates proper procedure for installing gypsum wallboard.
Instructor: Demonstrates proper concealment techniques for joints and fasteners.
Instructor: Demonstrates selected texturing applications.
Instructor passes out job and task sheets.
Students practice job and tasks under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Students install gypsum wallboard according to builder's plan.
Students conceal all joints and fasteners.
Students apply texture material.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.

Correct application and installation of gypsum wallboard is necessary for smooth interior surfaces. Good joints and fasteners concealment is also a must for smooth surfaces. Selection and installation of fasteners are important in producing sound, tight wall and ceiling applications of gypsum wallboard. Avoid cutting of face paper or fracturing the inner core of the gypsum wallboard panel.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 14

THE NEXT LESSON IS: VIII-B-2(S) "Installing Wall Paneling"

JOB SHEET VIII-B-1(J)
ON
INTERIOR WALL FINISHES

NAME OF JOB: Install Gypsum Wallboard

DRAWINGS: Blueprint of floor plan, elevations, and details

MATERIALS: As per specifications and details - gypsum wallboard, nails, adhesive

GENERAL INSTRUCTIONS: Study the plans and specifications. Determine the quantity and thickness of material best suited for the job.

When nailing, drive nail heads slightly below panel surface, leaving a slight depression (dimple) in the wallboard surface to be filled with joint compound. Be careful not to break the paper face or fracture the core of the panel.

Observe all safety rules and regulations. Wear the proper safety apparel for the job. Remember, gypsum wallboard is very heavy, lift correctly, ask for help when needed, and think safety at all times.

PROCEDURES AND/OR TASKS:
VIII-B-1(TS) Install Gypsum Wallboard in Ceilings and Walls
VIII-B-1a(TS) Concealment of Joints and Fasteners
VIII-B-1b(TS) Surface Texturing

TASK SHEET VIII-B-1(TS)

TASK: Install Gypsum Wallboard in Ceilings and Walls

JOB: Install Gypsum Wallboard

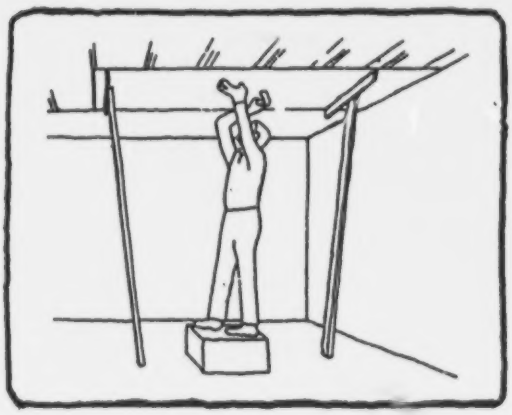
TRADE: Building Trades

TOOLS AND MATERIALS: Gypsum wallboard per builder's plans and specifications, pocket tape, straightedge, pencil, razor blade or hook blade knife, claw hammer, keyhole saw, sawhorses, proper safety equipment, support equipment, tin snips, corner bead, drywall nails

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions 3. Size of materials (width, length, thickness) as per specifications
2. Select Materials	1. Fasteners - size and type specified by manufacturer 2. Tapered ends - free of damage
3. Layout and Cut	1. Measure carefully 2. Score face of sheet with knife and straightedge 3. Place supports close to scored line 4. Press downward on overhang and snap core 5. Cut paper back with razor blade knife 6. Irregular shapes, curves, and cutouts can be cut with keyhole saw
4. Installing Gypsum Wallboard	1. Ceilings a. Check room corners for squareness at top plates b. Measure exact location where wallboard will be installed c. Layout and cut wallboard so that uncut ends will center on ceiling joists NOTE: Uncut ends have the tapered edges which aid in concealment of joint d. When adhesive is used or recommended, apply to bottoms of joists to be covered as per manufacturer's recommendations e. Position wallboard into place; end against top plate, side against adjacent top plate NOTE: Start in one corner of room and install wallboard panels perpendicular to the ceiling joists

STEPS | KEY POINTS



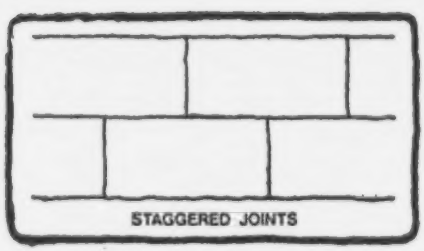
f. If working alone, wedge T-brace between floor and panel to support panel while nailing
g. Secure wallboard to ceiling joists with appropriate fastener. Space nails 7" apart and at least 3/8" from ends and edges

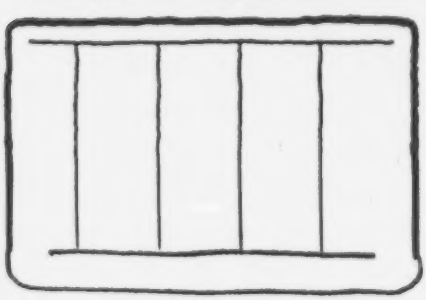
NOTE: Place fasteners at the center of wallboard and work outward

h. Continue installing gypsum wallboard until entire ceiling is covered

NOTE: Border sheets may have to be cut to finish run. Always place cut edge against top plates

2. Interior walls
   a. Check corner for squareness and plumbness
   b. Measure exact location where wallboard will be installed
   c. Layout and cut wallboard so that uncut end will center on wall stud
   d. When adhesive is used or recommended, apply to faces of studs to be covered as per manufacturer's recommendations
   e. For horizontal application, apply top panel first and in the corner, cut edges to the corner, fit ends and edges closely, stagger end joint
   f. Use vertical application when ceiling height is over 8'-2"





NOTE: Be sure to position all ends or edges of panels over and centered on framing members

   g. Secure wallboard to studs with appropriate fasteners using proper technique, space nails 8" apart and at least 3/8" from ends and edges
   h. Cut out for electrical switch and outlet boxes using keyhole saw
   i. Continue installation until wall is complete
   j. Check ceiling and walls for loose fasteners, replace or drive tighter as per situation
   k. If fastener has punctured face paper, place an additional fastener 1 1/2" from the fracture and remove faulty fastener
   l. Cut to length and install metal corner bead for all outside corners, space nails 5" apart

TASK SHEET VIII-B-1a(TS)

TASK: Concealment of Joints and Fasteners

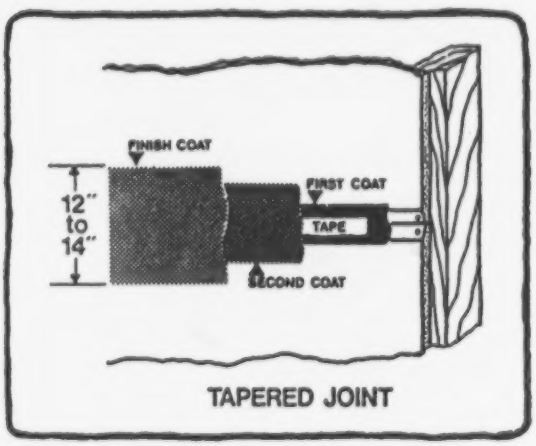
JOB: Install Gypsum Wallboard

TRADE: Building Trades

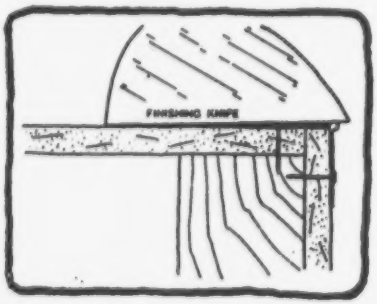
TOOLS AND MATERIALS: Assortment (4"-10") of joint finishing knives, pan for joint compound, joint compound, reinforcing tape, fine sandpaper

TASK BREAKDOWN:

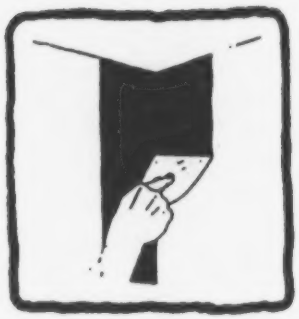
STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities, compare costs 2. Familiarize self with details 3. Determine most cost effective sizes
2. Preparation of Joint Compound	1. Mix or blend pre-mixed 2. Mix powder according to manufacturer's instruction
3. Concealment of Joints and Fasteners	1. Taped joints a. Check and make certain all fasteners are properly set NOTE: Slight dimple and paper face not broken b. Spread a bedding coat of joint compound into depression formed by joining tapered edges using a 4"-6" joint knife c. Center reinforcing tape over the joint and firmly press it into joint compound with joint finishing knife. Press hard enough to remove excessive compound and produce a smooth, wrinkle free seam d. Allow joint to dry 24 hours e. Apply second coat, extending (feathering) it a few inches beyond edge of taper f. Allow second coat to dry 24 hours g. Apply finish coat with 10" joint finishing knife, feathering the edges about 1 1/2" beyond the edges of the second coat h. After finish coat has dried, sand lightly with fine sandpaper if required NOTE: Fill dimples or depressions for fasteners with three coats of joint compound in conjunction with the joints 2. Outside corners a. Lay a sufficient amount of joint compound onto the flanges of the corner bead



TAPERED JOINT



STEPS	KEY POINTS



b. Level compound with joint finishing knife and extend it onto the face of the wallboard a minimum of 4"
c. Allow to dry 24 hours
d. Apply a second coat, feather compound onto the face of the wallboard 1 1/2" - 2" beyond the first coat
e. Allow to dry and sand lightly with fine sandpaper if required

3. Inside corners
   a. Using a 4" joint knife, or special corner knife, apply joint compound and spread out about 1 1/2" on each side of corner
   b. Cut joint tape the exact length of corner
   c. Fold tape in the center lengthwise and press it firmly into the corner
   d. Use just enough pressure and remove excessive joint compound
   e. Allow to dry 24 hours
   f. Apply second coat and feather out beyond first coat
   g. Allow to dry 24 hours
   h. Apply third coat if necessary and feather out beyond second coat
   i. After finish coat has dried, sand lightly with fine sandpaper if necessary

TASK SHEET VIII-B-1b(TS)

TASK: Surface Texturing

JOB: Install Gypsum Wallboard

TRADE: Building Trades

TOOLS AND MATERIALS: All purpose joint and texturing material, spray gun or texture roller, 2 gallon paint pan, 2" paint brush

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities, compare cost 2. Familiarize self with details
2. Preparation of Texture Material	1. Mix or blend pre-mixed 2. Mix powder according to manufacturer's instructions
3. Application of Surface Texture	1. Prepare the gypsum wallboard surface as recommended by manufacturer 2. Using texture roller or spray gun, apply texture material a. Roller - 1/2, 3/8, 3/4 nap paint roller or texture roller b. Light pressure for coarse texture, heavy pressure for fine texture c. Cross-roll texture as wall paints for complete coverage d. Spray gun - manufacturer's recommendation for application 3. Allow material to set or dry slightly, doesn't have to be completely dry, apply second coat where required or recommended

INSTRUCTOR'S PLAN VIII-B-2(I)
INFORMATIONAL LESSON

SUBJECT: Wall Panels

AIM: The student will be able to install paneling to interior walls following good building practices and procedures, blueprints and specifications.

TEACHING AIDS: Information Sheet VIII-B-2(IS), chalkboard/chalk

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 14
Durbahn, W.E. and Sundberg, E.W., Fundamentals of Carpentry, Chapter 7

PREREQUISITE EXPERIENCE OF THE LEARNER: The student(s) must have successfully completed previous lessons in Major Block VIII. The student must also exhibit a sincere interest in learning the building trades while meeting the requirements of the Texas Education Agency and local school district.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Wood paneling is available today in a wide variety of styles, textures, and colors. It can add unique elegance and warmth to a room while adding to the insulation value and the reduction of sound transmission. With its grain and grooving accents, a three-dimensional effect is gained, fasteners easily concealed and almost invisible joints are obtained.

Unlike other wall covering, paneling is a structural material that lets you correct or cover "problem walls". Paneling has a durable factory finish that can save decorating costs. A minimum maintenance is required as compared with the frequent replacement that's necessary with paint or wallpaper because many of the woods are hard and resist rough treatment.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Hardboard Paneling (Show Examples)	1. Composition - very dense, rigid board a. Wood fiber substrate b. Simulated woodgrain - painted surface c. Woodgrain - patterned paper laminated to face of panel d. Available in sheets or planks e. Scored to form a tile pattern, used in bathrooms and kitchens f. Can be impregnated with fire-retardant chemicals 2. Standard sizes a. Thickness - generally 5/32" to 1/4" b. Width of sheet 48", planks 16" and 24" c. Length of sheet 7', 8', 9', and 10' d. Length of planks - 8', 10', 12', 14', and 16'

NOTE: Most paneling sold in a 4' x 8' , panel

3. Advantages
   a. Economical
   b. Hard, smooth surface
   c. Structural strength
   d. Excellent wearing qualities
   e. Takes finish readily
   f. Easily worked with ordinary tools
   g. Can be bent with comparative ease into curved shapes
4. Disadvantages
   a. Expands and contracts slightly with changes in humidity
   b. Nail hole may have to be drilled for nails
   c. Tends to destroy set of saw blade

B. Plywood Paneling

(Show Examples)

1. Construction
   a. Hardwood face - veneer of oak, elm, birch, cherry, maple, walnut,
   b. Softwood face - veneer of pine, spruce, hemlock, western red cedar
   c. Three plies for 1/4" thickness
   d. Five plies for 3/8" thickness
   e. Glued with the grain of each layer perpendicular to each adjacent layer
   f. Outer layers called face and back
   g. Center layer(s) composes the core
2. Standard sizes
   a. Thickness - 1/4" and 3/8"
   b. Width - 48"
   c. Lengths - 7', 8', 10'
3. Advantages
   a. Structural strength
   b. Cost as compared to solid lumber paneling
   c. Tough, durable factory-applied finish
4. Disadvantages
   a. Expands and contracts slightly with changes in humidity
   b. Cost is greater than hardboard

C. Solid Wood Paneling

(Show Examples)

1. Made from hardwood and softwood
2. Grading - two categories
   a. Knotty - used for casual effect
   b. Clear - used for more formal appearance
3. Mill finished
   a. Rough-sawed - rustic effect
   b. Planed - smooth, dressed effect
   c. Machine-molded - produces shadowlines and decorative edges

d. Joints - board and batten strip, shiplap, or tongue and groove
4. Standard sizes
   a. Thickness - 3/4"
   b. Widths - range from 4" to 12"
   c. Lengths - range from 6' to 16'
5. Advantages
   a. Can be installed with a minimum of cutting and labor
   b. Easily installed
   c. Can be repaired and refinished
6. Disadvantages - cost of materials and labor as compared to the other types of paneling is much higher

D. Paneling Accessories and Use

(Show Examples)

1. Moldings - matches factory finished panels
   a. Inside and outside corners
   b. Cove
   c. Base
   d. Cap
   e. Seam
   f. Stool
   g. Casing
   h. Mullion
   i. Shoe
   j. Stop
2. Adhesives - eliminates countersinking and hiding of nail heads or lining up panel edges directly over studs
   a. May be applied to studs or over existing walls
   b. Surface should be sound and clean
   c. Packed in cartridges for application with a caulking gun

NOTE: Always follow the manufacturer's instructions when using adhesives

3. Colored putties - stick form
4. Fasteners
   a. Finish nails - countersink
   b. Colored paneling nails - heads left exposed
   c. Space nails 6" apart at panel's edge
   d. Space nails 12" apart in the panel field

E. Use of Furring Strips

1. Purpose - to provide a smooth, level surface
2. Where and when to use
   a. Poorly aligned studs
   b. Existing surfaces in poor condition
   c. Masonry walls
   d. Concrete walls
   e. Installing solid wood paneling in vertical position

3. How to install
   a. Horizontal - 16" apart on center
   b. Vertically - 48" apart on center
   c. Special fasteners for masonry and concrete walls

F. Estimating Quantities

1. Solid wood paneling
   a. Figured on the area(square feet) and thickness per specifications
   b. Formula for figuring area:
      Length ' x Width' = Area(sq. ft.)
      Example:
      15' x 20' = 300 sq. ft.
   c. Walls
      1) Add total perimeter of building
      2) Multiply by ceiling height
      3) Deduct area(sq. ft.) for windows and doors
      Example:
      Perimeter = 15' + 20' + 15' + 20'
      = 70'
      Area = 70' x 8'(ceiling hgt.)
      = 560 sq. ft.
      Net Area = 560sq. ft. - sq. ft. for windows and doors
      = X number of sq. ft.
   d. Determine number of pieces by dividing the total area in sq. ft. by sq. ft. in one piece
      Example: 1" x 6" x 8'
      Sq. ft./Board = $\frac{\text{Width"}}{12}$ x Length
      = $\frac{5.5 \text{ (nominal)}}{12}$ x 8'
      = 3.67 sq. ft.
      No. of Pieces = Area/sq. ft./piece
      = 560/3.67
      = 152.59 or 153 pcs. of 1" x 6" x 8'
2. Plywood or hardboard panels
   a. Total wall widths(perimeter)
   b. Divide by 4'
   Example:
   Perimeter = 15' + 20' + 15' + 20'
   = 70'
   No. of Panels = 70'/4'
   = 17 1/2 or 18

NOTE: If number falls between two whole, round up.

3. Furring - must figure the running feet required

G. Installation Procedures

1. Layout and measurement
   a. Locate studs, mark position on floor and ceiling
   b. Snap chalkline at 4' intervals
   c. Measure ceiling height, subtract 1/2" to maneuver panel
   d. Cut-outs for doors and window sections, electrical switches and outlets, and heat or cooling registers require careful measurements
   e. Cut-outs should fit snugly
   f. Cut panels from back when using circular saw
2. Placement
   a. First panel butted up against corner of room
   b. Plumb panel, first panel very important
   c. Left and right panel edges should have wall studs directly behind them when nailing
   d. Before installing, stand panels side-by-side around wall, rearrange for balance of color and grain pattern, number backs in sequence
3. Securing
   a. Nails, finishing
      1) Direct to stud, use 3d(1 1/4")
      2) Through wallboard, use 6d(2")
      3) Space 6" apart at panel's edges
      4) Space 12" apart in panel's field
   b. Nails, colored paneling
      1) Use 1" to secure directly to stud
      2) Use 1 5/8" to apply paneling to wallboard

   NOTE: Most vertical paneling is "random-grooved" with a groove at 16" centers for easy nailing and concealment of heads

   c. Adhesive - follow manufacturer's recommendations
      1) Apply continuous 1/8" bead along the top, bottom, and side edges
      2) On intermediate studs, apply beads of adhesive 3" long and spaced 6" apart

   NOTE: Do no more than one panel at a time

H. Related Safety

1. Apparel
   a. Proper clothing
   b. Proper eye protection
   c. Hard hat
   d. Respirator or filter mask (adhesive application)

2. Tools and equipment - proper use of:
   a. Claw hammer and nails
   b. Circular saw
   c. Hand saw
   d. Keyhole saw
   e. Saw horses

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have students identify various types of wall paneling.
2. Have students discuss advantages, methods of fastening, and installation of wall paneling.
3. Work example problems estimating wall paneling with students.
4. Take field trip to lumber yard or building materials center and determine what types of paneling and trim are available.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

Simple Recall

1. Wall paneling forms available are hardboard, plywood, and _____. Solid wood
2. Hardboard is a very dense, rigid board made of _____ fibers. Wood
3. Hardboard paneling surfaces are _____ or laminated on. Painted
4. _____ paneling is made of layers of veneer glued together Plywood
5. Solid wood paneling is _____ to produce shadowlines and decorative edges. Machine-molded
6. Hardboard and plywood paneling are commonly sold in _____ sized panels. 4' x 8'
7. _____ is used to trim and finish joints of wall paneling. Molding
8. _____ strips are used to smooth and level existing surfaces in poor condition before installing paneling. Furring
9. The use of an _____ makes it possible to install paneling without nails. Adhesive
10. Colored _____ nails do not have to be countersunk or covered with putty. Painted

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

Wood paneling is available in a wide variety of styles, textures, and colors. With the durable factory finish, a minimum of maintenance is required when compared to painted and wallpapered surfaces. Paneling is decorative and provides structural strength, insulating value and reduces sound transmission.

Paneling is available in three basic types: hardboard, plywood, and solid wood. Hardboard is produced from wood fibers subjected to heat and pressure. Surfaces are then painted to simulate woodgrain or woodgrain-patterned paper is laminated to face of panel. Very economical to install.

Plywood paneling is face-veneered with either hardwoods or softwoods such as oak, walnut, pine, birch, etc. Panels 1/4" thick are generally 3 ply and 3/8" thick are 5 ply. Like hardboard paneling, plywood paneling is commonly manufactured in 4' x 8' panels or sheets.

Solid wood paneling is made of hardwood and softwood boards that usually have tongue and groove joints for blind nailing. It is available in rough-sawed or planed surfaces. Vertical application requires the addition of furring strips. When applied horizontally, the boards are nailed directly to studs. Most costly of paneling applications.

Molding is used for covering seams and joints at the ceiling and/or floor, and protecting corners. Molding is available in many various shapes, types, and factory finishes that match the paneling.

Adhesives are used to eliminate countersinking and hiding of nail heads or lining up panel edges directly over studs. Putties are available for concealing countersunk nails. Always follow manufacturer's instructions when using adhesives.

Furring strips are required for poorly aligned studs, existing surface in poor condition, concrete and masonry walls, and vertical application of solid wood paneling. They provide a smooth, level surface for fastening paneling when installed properly.

The amount of paneling material required for the job is figured by the square foot or by the number of pieces. To calculate square feet, use this formula:

Area(square feet) = Length in feet x Width in feet

To calculate the number of pieces, use this formula:

No. of pieces = Area(sq. ft.)/sq. ft. per piece of material

Before paneling material is installed, it should be allowed to condition to the room atmospheric conditions. Stand hardboard and plywood panels on end side-by-side around wall and rearrange for balance of color and grain pattern, then number the backs of each panel in sequence.

Pay particular attention to the safe handling and installation of wood paneling. Wear the proper safety equipment and apparel for the job and use all tools correctly and safely.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Chapter 14

THE NEXT LESSON IS: VIII-C-1(I) "Finish Flooring"

INFORMATION SHEET VIII-B-2(IS)
ON
INTERIOR WALL FINISHES

SUBJECT: Wood Panels

INTRODUCTORY
INFORMATION:

Wood or wood-appearing materials have become very popular for interior wall coverings. This is particularly true in living, dining, den, and recreational areas of the home. Mobile home manufacturers have used it almost exclusively as interior wall coverings in their homes.

Paneling is available in a wide variety of styles, textures, colors, and factory finishes. The student(s) of building trades will probably be required, at some point, to install wood paneling. The student(s) needs to have a good working knowledge of wood paneling: types, quantities, cost, installation, and other aspects that apply to its selection and use.

GENERAL INFORMATION:

WOOD PANELING

Wood or wood-byproduct paneling are practical wall coverings because they are hard and resist rough treatment very well. Wood is very durable and with durable factory finishes, it requires minimal maintenance.

Wood paneling is available in three basic types:

1. **Hardboard Paneling** is made by pressing fibrous wood into very hard, dense, and rigid board. Panels are available in simulated woodgrain - painted surface such as walnut, pecan, chestnut, birch, oak, etc. Or woodgrain-patterned paper may be laminated to the face of the panel. Others are plain for painting or scored to form a tile pattern that is often used in baths and kitchens. If building codes require a flame-retardant surface, panels are available that are impregnated with fire-retardant chemicals.

   Hardboard is available in sheets or plank form. Sheets are supplied in 4' x 7', 4' x 8', and 4' x 10' panels which vary from 5/32" to 1/4" thick. Most panels are "random-grooved", with a groove at 16" centers for easy nailing. Planks are 16" to 24" in width and lengths of 8', 10', 12', 14', and 16'. Panels should be placed separately around the room for 48 hours to allow them to adjust to atmosphere conditions.

   Fasteners such as finishing and colored paneling nails or adhesives may be used to secure hardboard panels directly to framing members or through wallboard. If plain finishing nails are used, they should be countersunk and holes filled with a matching colored putty stick. Follow the manufacturer's recommendation on the selection and use of adhesives.

   Hardboard panels may be cut by a 10-tooth or more cross-cut handsaw or a power circular saw. If power saw is used, cut from the back of the panel to minimize splintering. A keyhole saw is very useful for "cut-outs" for electrical boxes.

Caution: Be sure to wear protective eyewear whenever using a hammer or power and cutting tools.

2. **Plywood paneling** is made by gluing veneer plies together. The plywood panel is generally constructed with odd numbers of plies, such as 1/4" plywood paneling. The outside layer with the hardwood or softwood veneer surface exposed when installed is called the face. The other side is the back and the inner ply or plies is called the core.

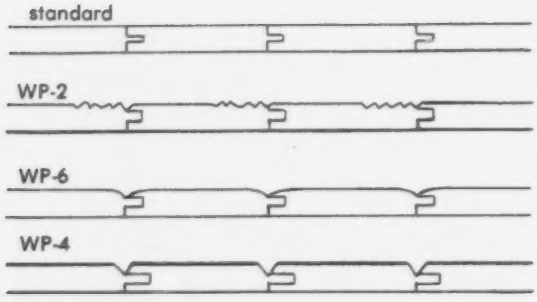
   The natural hardwood face-veneer plywood panels have beautiful patterns of oak, walnut, birch, cherry, maple and other real woods. Softwood face-veneer plywood panels use pine, spruce, hemlock and western red cedar. Plywood, like hardboard panels, are "random-grooved", with a groove at 16" centers for easy nailing.

RANDOM-GROOVED PANEL

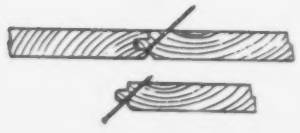
   Plywood panels are usually 4' x 8' and installed in the same manner as hardboard panels. Fasteners and adhesives are basically the same. Prefinished plywood panels should be stacked horizontally with 1" stripping between each face-to-face panel 48 hours prior to installation. This conditions the panels to the temperature and humidity of the room.

3. **Solid wood paneling** is made from hardwood and softwood that has either been rough-sawed or planed finish. The rough-sawed gives a rustic effect and the planed appears smooth. Solid wood paneling is graded knotty or clear. Clear, solid wood paneling has a more formal appearance than that of the grade knotty, which is used for a more casual look.

   Solid wood boards range from 4" to 12" in widths (nominal size) and are dressed to 3/4" in thickness. The boards most commonly used have tongue-and-groove joints and are blind nailed, eliminating countersinking of nail heads. The panels are also machined-molded to produce shadowlines and decorative edges.



Tongue and groove designs for solid wood paneling.



Blind Nailing

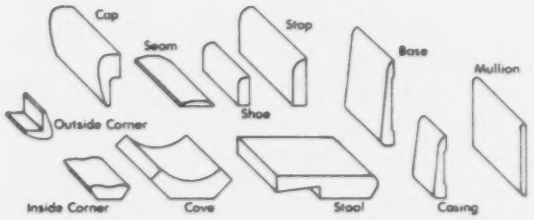
When solid wood paneling is installed horizontally, the boards are nailed directly to the studs. When installed vertically, furring strips are required.

PANELING ACCESSORIES AND USE

Moldings are thin strips of wood, wood fibers, plastic or metal which are made in a variety of shapes and sizes. The right moldings add the final decorative accent for the paneling job, like framing a picture. They also cover seams and joints at ceiling or floor levels and protect corners and walls.

Moldings are available as prefinished molding that are used to complement or match factory prefinished paneling. It is also available in unfinished molding that is stained to harmonize or contrast with the installed paneling.

A professional job requires precision in working with moldings: precise measurements, careful cutting, skillful use of hammer and nailset, tasteful finishing steps with putty stick and paint or stain.



COMMON SHAPES OF MOLDING

Adhesives may be used to eliminate countersinking and hiding of nail heads or lining up panel edges and grooves directly over studs, if panels are applied over an existing wall surface. Adhesive may be applied directly to studs or over existing walls as long as the surface is sound and clean. A caulking gun with adhesive tube is the simplest method of application.

When using adhesive, make certain, before you start, that the paneling is properly cut and fitted and that the wall and panel are free from dirt and dust. Once the panel is applied with adhesive, adjustment may be difficult.

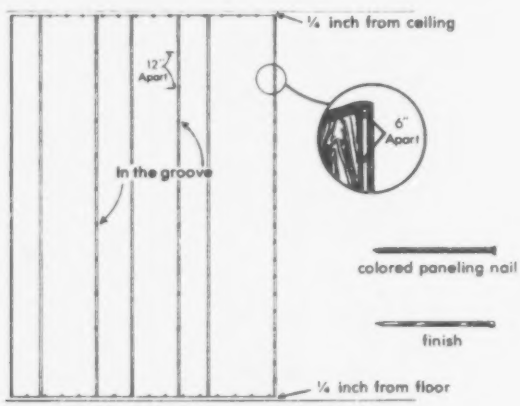
Be sure to read the adhesive manufacturer's instructions and follow them carefully.

Fasteners used for wall paneling are generally finishing nails or colored paneling nails. Finishing nails are designed to be countersunk and covered with a matching putty. If colored paneling nails are used, there is no need to countersink or use putty.

As mentioned earlier, panels are random-grooved to create the effect of natural lumber planks. But check carefully and you'll notice there's usually a groove every 16". This allows nailing in the grooves, where nails holes are less visible and into the underlying studs.

For panels of plywood and hardboard, use 3d (1 1/4") finishing nails, but if you are nailing through any kind of wallboard or plaster, use 6d (2") nails to get a solid "bite" into the stud. Space your nails 6" apart at the panel's edge and 12" apart in the interior of the panel. Use a nail set to countersink the nail heads slightly below the surface, then fill with a matching putty stick. If you use colored paneling nails, use 1" nails to secure paneling to studs or 1 5/8" nails to apply paneling to wallboard or plaster.

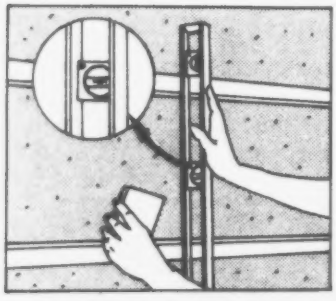
When nailing solid wood paneling, use a 6d (2") finishing nail and drive it at a 45^{0} angle into the base of the tongue and on into the stud or furring strip. This is referred to as blind nailing.
Caution: Be sure to wear protective eyewear whenever using hammer and nails.



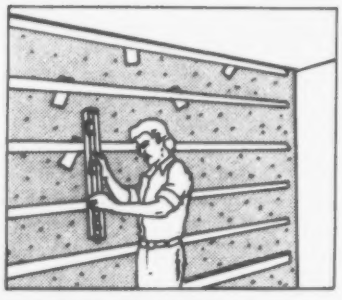
FURRING STRIPS

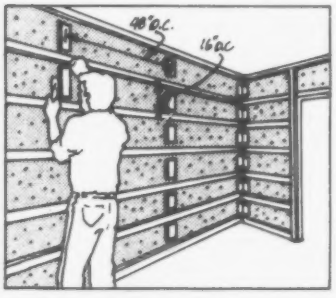
Furring strips are narrow strips of wood spaced for a nailing base for another surface. Furring strips for paneling are either 1" x 2", 1" x 4", or 2" x 3" lumber, or 3/8" to 1/2" plywood strips cut 1 1/2" wide. Furring strips are used when there are: poorly aligned studs, existing surfaces in poor or damaged conditions, masonry and concrete wall, or solid wood paneling installed in the vertical position.

Furring strips are commonly spaced 16" apart when applied horizontally and 16" to 48" apart for vertical application. Wedges are used in low spots to shim and level the strips to provide a smooth, level surface.



LEVELING AND SHIMMING





SPACING

On stud walls, the strips may be installed right through the shimming wedges and wallboard into the underlying studs. Depending on thickness of strips and/or wall covering, use 6d(2") or 8d(2 1/2") common or box nails.

For masonry or concrete walls, use specially hardened masonry nails. Or drill a hole with a carbide-tip bit, insert wooden plugs or expansion shields, and nail or bolt frame in place. Adhesive can also be used to apply furring strips to masonry or concrete walls.

ESTIMATING MATERIALS

To determine the number of pieces of solid wood paneling, determine the total square feet of surface area and divide the total area by the sq. ft. in each piece of selected type and size. Remember to deduct for windows and doors as this type of paneling is generally quite expensive. The formula(s) for figuring the amount of solid wood paneling are:

Area(square feet) = Height in ft. of ceiling x Length in ft. of wall

$$\text{Sq. Ft./Piece} = \frac{\text{Width in inches of board}}{12} \times \text{Length in feet}$$

Number of Pieces = Area(sq. ft.) / Sq. Ft./Piece

Example: An interior wall 8' in height and 24' in length will require 192sq.ft. or 18 pieces of 1" x 8" x 16' solid wood paneling.

Area(sq. ft.) = Height' x Length' or 8' x 24' = 192 sq. ft.

$$\text{Sq. ft./piece} = \frac{\text{Width'}}{12} \times \text{Length' or } \frac{8"}{12} \times 16' = 10.67 \text{ sq. ft.}$$

$$\text{No. of Pieces} = \text{Area(sq. ft.) / Sq. Ft./Piece or } \frac{192}{10.67} = 18 \text{ pieces}$$

To calculate the number of 4' x 8' (most common) panels of plywood or hardboard paneling, total the wall perimeter and divide by 4' (the width of one panel).

Example: A room 14' x 16' would require 15, 4' panels of either plywood or hard board paneling.

Perimeter = 14' + 16' + 14' + 16' = 60'
Number of Panels = 60' / 4' = 15 panels

Charts such as the following are also very helpful for determining the number of panels. If the perimeter falls between two numbers, "round up" to the higher number.

Perimeter	No. of 4' x 8' panels needed
36'	9
40'	10
44'	11
48'	12
52'	13
56'	14
60'	15
64'	16
68'	17
72'	18
92'	23
96	24
100'	25
104'	26
108'	27
112'	28
116'	29
120'	30

Example: A room 15' x 18' would require 17, 4' x 8' panels.

Perimeter = 15' + 18' + 15' + 18' = 66' = 17 panels

(Solution) 66' falls between 64' and 68' on chart, round up to the next highest number which is 17.

Remember: Deduct for windows and doors.

SAFETY

While installing paneling, careful attention should be paid to the safety of the worker. Proper safety apparel should be worn at all times. Be sure to wear protective eyewear whenever using a hammer or power and cutting tools. Always READ and FOLLOW the manufacturer's instructions when using power tools and adhesives.

INSTRUCTOR'S PLAN VIII-B-2(S)
MANIPULATIVE LESSON

TASK: Install Wood Paneling

AIM: The student will be able to correctly install wood wall paneling.

TOOLS AND EQUIPMENT: Safety equipment, tape measure, framing square, level, plumb bob, chalkline, circular saw, crosscut hand saw, keyhole saw, hammer, nail set, hand drill and twist drill, caulking gun, miter box and saw, saw horses

MATERIALS: As per builder's plans and specifications, wood paneling, nails (finishing or colored paneling), adhesive, furring ma terials, fasteners for furring strips

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 14

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must have successfully completed related lesson, VIII-B-2(I).

CHECKING STANDARDS: Teacher: check on quality/procedure of student's work.
Example:
1. Selection of material.
2. Accurate quantity of materials and supplies.
3. Installation methods.
4. Quality of work.
5. Selection of tools.
6. Safe work habits.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

For a quality job of installing paneling, careful consideration should be given to: quality of work, proper installation methods, and trimming. The manufacturer's instructions for all materials should be followed closely to insure the proper use of the selected materials for interior wall paneling. For a professional looking and trouble free project, be sure to begin with essential planning and preparation.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Material Selection	1. As per building plan, estimations 2. Check condition, return damaged materials 3. Finished desired, factory prefinish or unfinished
2. Preparation of Materials	1. Store or stack properly 2. Condition to atmospheric conditions per manufacturer's suggestions 3. Arrange for most pleasing woodgrain effect 4. Number panels in order of installation

5. Mark locations of cut-outs, electrical switches and outlets, heat and cooling register, etc.
6. Cut to widths and lengths as required

3. Installing Hardboard or Plywood Paneling

1. Installed directly to studs
   a. Not recommended for hardboard
   b. Use 3/8" plywood thickness
   c. Attach building paper or polyethylene vapor barrier on exterior walls
   d. Stand panels side-by-side before installation

   NOTE: Panels should have been conditioned to the room's atmospheric conditions 48 hours prior to installation

   e. Rearrange panels for most pleasing balance of color and grain effect
   f. Number back of panels in order of installation
   g. Start in one corner of room, position and plumb first panel

   NOTE: Allow 1/4" space between bottom of panel and floor

   h. Begin in the center of panel and place a 3d finish nail or 1" colored paneling nail on 12" center, nail in groove when possible

   NOTE: Countersink finish nails and fill with matching putty stick

   i. Nail edges last, space nails 6" apart, at least 1/4" from edge
   j. If adhesive is used instead of nails:
      1) With caulking gun and tube adhesive, apply continuous 1/8" bead to outside edges on the back side of panel
      2) On intermediate studs, apply beads 3" long and spaced 6" apart
      3) Set panel in place and press firmly along edges and stud lines
      4) Read and follow instructions of manufacturer
   k. Position and secure remaining panels
      1) Cut-outs for door and window sections, electrical switches and outlets, or heat and cooling registers require careful measurement
      2) Cut-outs are made from front of panel with keyhole saw
      3) Length and width cuts for panels less than 4' x 8' are made with power saw from back of the panel to minimize splintering
   l. Install necessary molding

CAUTION: Be sure to wear proper eye protection when using a hammer or power and hand cutting tools

2. Installed over wallboard
   a. Locate studs
      1) Measure 16" from one corner
      2) With nail and hammer probe for stud
      3) If stud is missed with first probe, make test holes at 3/4" intervals on either side of first hole until stud is located
      4) Make light pencil mark on floor and ceiling
      5) Snap chalkline and repeat at 4' intervals
      6) Test occasionally to determine that studs are still on 16" centers
   b. From this point, follow the same procedure for installing plywood paneling directly to studs

   NOTE: Holes may need to be drilled in hardboard panels prior to nailing
3. Installed on furring strips - masonry or poor stud wall conditions
   a. Install furring strips horizontally on 16" centers with 6d or 8d common or box nails

   NOTE: For masonry or concrete walls, use specially hardened nails or other types of fasteners
   b. Use wood shingles or wedges between wall and strips to insure levelness, check with level or plumb bob
   c. Install vertical furring strips, 16" to maximum of 48" on center
   d. From this point, the paneling can be applied with either nails or panel adhesive as discussed earlier

4. Installing Solid Wood Paneling

1. If paneling is installed vertical, install furring strips as discussed earlier
2. Cut board to length, less 1/4" from ceiling and floor
3. Start at one corner, position and plumb first board

NOTE: Very important to get the first board plumb

4. Face nail edge of board in the corner, blind nail base of tongue to furring strips, 6d finish nail
5. Position tongue and groove to either and blind nail into furring strip
6. Position and secure remaining boards in the same procedure

a. Butt interior corners together
b. Miter or use corner molding to finish exterior corners

NOTE: Most all joints at the ceiling, floor and corners are usually covered by molding

5. Safety

1. Observe all safety rules and regulations
2. Use the correct tool for the job
3. Wear proper safety apparel
4. Follow manufacturer's recommendations
5. Think safety at all times, no horseplay

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates proper procedure for installing wood paneling.
Instructor: Demonstrates proper countersinking and filling or concealing of nail heads.
Instructor: Demonstrates proper trimming techniques.
Instructor passes out job and task sheets.
Students practice job and tasks under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Students install wood paneling per builder's plans and specifications.
Students install molding necessary for trim.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

There is no substitute for quality work. Correct planning and application will result in a professional-looking and trouble-free project. Read and carefully follow the instructions of the manufacturer for the use and application of their product. Take time to fill all nail holes and cutting of trim. Use all tools for the purpose they were intended to be used. Work safely and think of others.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 14

THE NEXT LESSON IS: VIII-C-1(S) "Finish Flooring"

JOB SHEET
ON
INTERIOR WALL FINISHES

VIII-B-2(J)

NAME OF JOB: Install Wall Paneling

DRAWINGS: Builder's construction plans, detailed drawings

MATERIALS: As per specifications and details - paneling, nails, adhesive, furring strips, colored putty molding

GENERAL INSTRUCTIONS: Study the plans and specifications. Determine the quantity and type of paneling best suited for the job.

Be sure to condition paneling prior to installation per manufacturer's instructions. Install nails in grooves when possible for better concealment. Take a few minutes to stand panels side-by-side around the wall of the room. Rearrange them to achieve the most pleasing balance of color and grain pattern. Number the panel and install them in proper order.

All cuts and cut-outs should be as neat as possible. Care should be taken in using power and hand tools. Observe all safety rules and regulations.

PROCEDURES AND/OR TASKS: VIII-B-2(TS) Install Hardboard and Plywood Panels
VIII-B-2a(TS) Install Solid Wood Paneling

TASK: Install Hardboard or Plywood Paneling

JOB: Install Wood Paneling

TRADE: Building Trades

TOOLS AND MATERIALS: Paneling per builder's plan and specifications, pocket tape, framing square, level, plumb bob, chalkline, circular saw, crosscut hand saw, keyhole saw, hammer, nail set, hand drill and twist drills, caulking gun, miter box and saw, sawhorses, nails (finishing or colored paneling), adhesive tubes, furring materials, fasteners for furring strips, pencil, safety equipment

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions 3. Sizes of material (width, length, thickness) as per specifications
2. Select Materials	1. Fasteners a. Nails - size, type, and quantity b. Adhesive - manufacturer's recommendations 2. Colors and grain patterns 3. Per job application and requirements
3. Layout and Cut	1. Measure carefully, panels should be 1/2" less than ceiling to floor distance 2. Transfer measurement to back of panel and mark with straightedge and pencil or chalkline 3. Support and protect panel surface on sawhorses 4. If power circular saw is used, cut panel from back NOTE: Be sure to wear protective eye wear whenever using power or hand cutting tools 5. If crosscut hand saw is used, cut panel from front 6. Irregular shapes, curves, and cutouts with keyhole saw from the front NOTE: It is highly desirable to cut panel so that edges are supported and centered on studs or supports directly below
4. Installing Hardboard or Plywood Paneling	1. Installed directly to studs a. Not recommended for hardboard b. Use 3/8" plywood thickness c. Attach building paper or polyethylene vapor barrier on exterior walls

STEPS	KEY POINTS

d. Stand panels side-by-side before installation

NOTE: Panels should have been conditioned to the room's atmospheric conditions 48 hours prior to installation

e. Rearrange panels for most pleasing balance of color and grain effect

f. Number back of panels in order of installation

g. Start in one corner of room position and plumb first panel

NOTE: Allow 1/4" space between bottom of panel and floor

h. Begin in the center of panel and place a 3d finishing nail or 1" colored paneling nail on 12" center, nail in groove when possible

NOTE: Countersink finishing nails and fill with matching putty stick

i. Nail edges last, space nails 6" apart, at least 1/4" from edge

j. If adhesive is used instead of nails:
   1) With caulking gun and tube adhesive, apply continuous 1/8" bead to outside edges on the back side of panel
   2) On intermediate studs, apply beads 3" long and spaced 6" apart
   3) Set panel in place and press firmly along edges and stud lines
   4) Read and follow instructions of manufacturer

k. Position and secure remaining panels
   1) Cut-outs for door and window sections, electrical switches and outlets, or heat and cooling registers require careful measurement
   2) Cut-outs are made from front of panel with keyhole saw
   3) Length and width cuts for panels less than 4' x 8' made with power saw from back of the panel to minimize splintering

l. Install necessary molding

CAUTION: Be sure to wear proper eye protection when using a hammer, or power and hand cutting tools

2. Installed over wallboard
   a. Locate studs
      1) Measure 16" from one corner
      2) With nail and hammer probe for stud

STEPS	KEY POINTS

3) If stud is missed with first probe, make test holes at 3/4" intervals on either side of first hole until stud is located
4) Make light pencil mark on floor and ceiling
5) Snap chalkline and repeat at 4' intervals
6) Test occasionally to determine that studs are still on 16" centers

b. From this point, follow the same procedure for installing plywood paneling directly to studs

3. Installed on furring strips - masonry or poor stud wall conditions
   a. Install furring strips horizontally on 16" centers with 6d or 8d common or box nails

   NOTE: For masonry or concrete walls, use specially hardened nails or other types of fasteners

   b. Use wood shingles or wedges between wall and strips to insure levelness, check with level or plumb bob
   c. Install vertical furring strips, 16" to a maximum of 48" on center
   d. From this point, the paneling can be applied with either nails or panel adhesive as discussed earlier

TASK: Install Solid Wood Paneling

JOB: Install Wood Paneling

TRADE: Building Trades

TOOLS AND MATERIALS: Paneling per builder's plans and specifications, pocket tape, framing square, level, plumb bob, chalkline, circular saw, crosscut hand saw, keyhole saw, hammer, nail set, hand drill and twist drills, caulking gun, miter box and saw, sawhorses, nails (finishing and colored paneling), adhesive tubes, furring materials, fasteners for furring strips, pencil, safety equipment

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material types and quantities 2. Familiarize self with details and dimensions 3. Sizes of materials (width, length, thickness) as per specifications
2. Select Materials	1. Determine fasteners - size, type, and quantity 2. Per job application and requirements 3. Colors and grain patterns 4. Joint types
3. Measure and Cut	1. Measure carefully the points of installation for board, vertically, horizontally 2. Transfer measurement to board and mark with straightedge and pencil 3. Support board on sawhorse(s) and cut to correct length, less 1/2" measured length NOTE: Be sure to wear protective eye wear whenever using power or hand cutting tools
4. Installing Solid Wood Paneling	1. If paneling is installed vertical, install furring strips as discussed earlier in VIII-B-2(TS) NOTE: Furring strips are not required when paneling is applied horizontally 2. Cut board to length, less 1/4" from ceiling and floor or wall to wall 3. Start at one corner, position and plumb first board NOTE: Very important to get the first board plumb 4. Face nail edge of board in the corner, 6d finishing nail 5. Blind nail base of tongue to furring strips, 6d finishing nail

STEPS	KEY POINTS
	6. Position tongue and groove together and blind nail into furring strip 7. Position and secure remaining boards in the same procedure a. Butt interior corners together b. Miter or use corner molding to finish exterior corners NOTE: Most all joints at the ceiling, floor and corners are usually covered by molding

INSTRUCTOR'S PLAN VIII-C-1(I)
INFORMATIONAL LESSON

SUBJECT: Wood Flooring

AIM: The student will be able to effectively install various types of wood floors found in modern home construction, while following acceptable building practices and procedures.

TEACHING AIDS: Information Sheet VIII-C-1(IS), chalkboard/chalk

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 15

PREREQUISITE EXPERIENCE OF THE LEARNER: The student(s) must exhibit a sincere interest in learning the building trades while meeting the requirements of the Texas Education Agency and local school. The student(s) must also have successfully completed previous lesson in Major Block VIII.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

For many years wood has been a widely used material for Finish Flooring (the final wearing surface of the floor) in residential construction. Woods like oak, maple, beech, birch, pecan, southern pine, and Douglas fir have been used for many years for flooring. Finish flooring materials made of wood are usually machine matched; that is, the boards have a tongue and groove to produce a smooth, tight floor.

Wood flooring is selected for many reasons. Floors made of wood are selected because of their durability to withstand wear, beauty of appearance, relatively easy to maintain and low heat conductivity. The grain structure, texture, and color of wood can be made to blend and compliment the surrounding environment.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Desirable Qualities of Wood Flooring Passout: VIII-C-1(IS)	1. Offers both beauty and durability 2. Easy to maintain 3. Has high resistance to wear 4. Has low heat conductivity 5. Grain structure, texture and color blend with surrounding environment
B. Woods Used for Flooring (Show Examples)	1. Hardboards - broad-leaved trees a. Oak - parquet flooring squares b. Maple NOTE: Most popular c. Birch d. Beech e. Pecan 2. Softwoods - evergreen or needle bearing trees a. Southern pine b. Douglas fir NOTE: Edge-grain surface

NOTE: Names of hardwood and softwood do not indicate hardness

C. Types of Flooring

1. Strip flooring - varies in length from 1' to 16', face width of 2 1/4"
   a. Ends and sides - tongue & groove, very common square edge
   b. Bottom face of strip undercut for installation purposes, irregularities
   c. Top face narrower than bottom face for tight fit and smooth finish surface
2. Plank flooring - widths range from 3" to 9" in multiples of 1", random lengths
   a. Ends and sides - tongue and groove (end-or side-matched)
   b. Generally red or white oak
   c. Bored and plugged with wooden plugs of contrasting colors
   d. Popular during colonial times
3. Block flooring - 6 3/4"-, 9"- or 1 1/4" squares
   a. Laminated units, pieces of strips bonded together edgewise or ply construction
   b. Units tongue and grooved
   c. Blocks laid with grains at right angle with surrounding units

D. Grades and Sizes of Floor Woods

1. Based mostly on appearance stock
   a. Other considerations - knots, wormholes, color and percentage of long and short pieces per bundle
2. Cooperation with U.S. Bureau of Standards
3. National Oak Flooring Manufacturers' Association
   a. Quarter-sawed
      1) Clear
      2) Select
   b. Plain-sawed
      1) Clear
      2) Select
      3) No. 1 common
      4) No. 2 common
      5) 1 1/4' shorts
   c. All grades made in these combinations
      1) 25/32" thickness, 3 1/4"-, 2 1/4"-, 2"-, and 1 1/2" widths
      2) 1/2" and 3/8" thickness, 2"-, and 1 1/2" widths
4. Maple Flooring Manufacturer's Association
   a. First grade
   b. Second grade
   c. Selected first grade, light northern hard maple

d. Selected first grade, amber northern hard maple
e. Selected first grade, red
f. All grades made in these combinations:
   1) 25/32" thickness, 3 1/4"-, 2 1/4"-, 2-", and 1 1/2" widths
   2) 5/8", 1/2" and 3/8" thickness, 2 1/4"-, 2"-, and 1 1/2" widths
   3) Planks - 25/32" thickness, 3" to 9" in 1" multiples
   4) Blocks - 25/32" thickness, unit blocks are in multiples of strip dimensions, width 6 3/4" x 6 3/4", 9" x 9", 11 1/4" x 11 1/4"

E. Estimating Materials

1. Figure on the area(sq. ft.) and thickness per specification
2. Formula for figuring area:
   Length(ft.) x Width(ft.) = Area(sq. ft.)

Example:
20' x 24' = 480 sq. ft.

3. Figure board feet for strips by multiplying area(sq. ft.) times a size percentage factor

Example:
480 + 30% of 480 = 624 bd. ft.

4. Number of bundles - divide total bd. ft. per room by 24 bd. ft. per bundle

Example:
624/24 = 26 bundles

5. Block flooring packaged in boxes and covers x number of sq. ft. per box

F. Methods of Installation

1. Strip flooring
   a. Nailed to subflooring
      1) Bund nailed, 45^{0} to 50^{0} angle
      2) Portable nailer or hammer and nail set

      CAUTION: Proper eye protection should be worn at all times
      3) Type, size and spacing of nail per manufacturer's instructions
      4) Cover subfloor with quality building paper
      5) Laid at right angle to floor joist
      6) Leave a 1/2" to 5/8" space (expansion joint) between walls and flooring material

      NOTE: Expansion joint helps prevent warpage and buckling of floor by compensating for increased moisture and drastic temperature changes
      7) Stagger the joints

8) Start at either sidewall
b. Installed over concrete floor
1) Requires sleeper (1" x 2") attached directly to concrete with mastic and nails (1 1/2" concrete nail), 16" on center
2) .004 polyethylene film coverage of all sleepers
3) Nail another sleeper over polyethylene, 4d on 16" - 24" apart
4) Follow the same procedure of installing strips to subflooring
2. Plank flooring - installed in similar manner as strip flooring
3. Block flooring - unit or laminated blocks
a. Installed on wood subflooring
1) Start in center of room and work out to sidewall
2) Leave about 1" expansion joint
3) Apply mastic or nail in place per manufacturer's specifications, 30 lb. asphalt saturated felt
4) Thickness of mastic determined by notched trowel selected

GENERAL NOTE: Manufacturers' recommend "conditioning" wood flooring four to five days prior to installation

G. Related Safety

1. Apparel
a. Proper eye protection
b. Hard hat
c. Body protection
2. Tools and equipment, proper use of:
a. Manual and pneumatic portable nailers
b. Claw hammer and nail set
c. Power or hand saws

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have student(s) identify the three basic types of wood flooring.
2. Have student(s) discuss the reasons for selecting wood flooring materials.
3. Discuss with the student(s) preparation required and installation of wood flooring types.
4. Work example problems estimating flooring materials with the student(s).
5. Have student(s) complete Assignment Sheet VIII-C-1(AS).

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

True-False

1. Woods like oak and maple are popular softwoods used for wood flooring. False
2. Wood for finished floors is selected because of its durability to withstand wear and for its appearance. True
3. Tongue and grooved strip flooring is also referred to as side-and-end matched. True
4. Plank flooring is available in 6 3/4"-, 9"-, and 11 1/4" squares of random length. False
5. The National Oak Flooring Manufacturers' Association in cooperation with the U.S. Bureau of Standards establish uniform grade rules for hardwoods such as oak and maple. False
6. The names hardwood and softwood indicates the degree of hardness. False
7. The grades of wood flooring are based mostly on their appearance. True
8. Common thickness of all grades of oak and maple strip flooring are 3/8", 1/2", and 25/32". True
9. Area in square feet is determined by multiplying length in feet by width in feet by thickness in inches. False
10. Expansion joints help maintain smooth, flat floor surfaces. True

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

Hardwoods and softwoods have been used for many years for wood flooring. Major reasons for using wood for flooring is because of its durability, high resistance to wear, beauty, easy to maintain, and low heat conductivity. The grain structure, texture, and color can also be made to blend and compliment the surrounding environment.

Strips, planks, and blocks are the three general types of wood flooring materials used in residential construction. These flooring materials are available in various grades and sizes. Uniform grading rules are established in cooperation by manufacturers and the U.S. Bureau of Standards. Standard thicknesses are 3/8", 1/2" and 25/32". Strips and planks are sold in random lengths and generally available in width ranging from 1 1/2" to 3 1/4". All three groups are generally

tongue and grooved, both ends and sides. This is also referred to as side-and-end matched.

Material amounts are determined by figuring area in square feet and board feet. Bundles of strip flooring are commonly packaged in 24 bd. ft. per bundle. Block flooring is sold in boxes containing 25 sq. ft.

Strip and plank flooring are installed perpendicular to floor joists. "Sleeper" strips on 16" centers are used to install strip and plank flooring over concrete slabs. A moisture barrier is required between sleepers and finish flooring. Blind nailing conceals nails.

Block flooring can be nailed in place or laid in mastic. Follow manu-facturer's information and procedures when using a mastic.

The handling and installation of wood flooring requires that careful attention be paid to proper and safe work habits, observance of all safety rules and the correct use of hand and power tools.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Chapter 15

THE NEXT LESSON IS: VIII-C-1(I) "Finishing of Wood Floors"

INFORMATION SHEET
ON
FINISH FLOORING

VIII-C-1(IS)

SUBJECT: Wood Flooring

INTRODUCTORY
INFORMATION:

Wood comes from the earth's trees and forests and is one of our nation's great natural resources. Wood has played an important role in the development of this country and has given rise to many of its large industries. Wood and/or wood products touch practically every citizen, every day of their life. Just look around you! Make a quick survey of items produced from wood. This will give you some indication of its many uses and applications.

Woods such as oak and maple have been popular hardwoods used for Finish Flooring (the final wearing surface of the floor) in residential construction. A wide selection of wood flooring is manufactured today. Hardwoods and softwoods are available in strip, plank, and block form. They come in a wide variety of widths and thicknesses. Lengths are random and the wood material may be solid, unit-block, or laminated together.

Care should be taken on the student(s) part in the selection and installation of wood flooring. He/she must have a good working knowledge of kinds, grades, sizes and other aspects that apply to its selection and use. Since wood flooring is a fixed and relatively permanent part of the home it should be of high quality so that replacement and repair will seldom be required.

GENERAL INFORMATION:

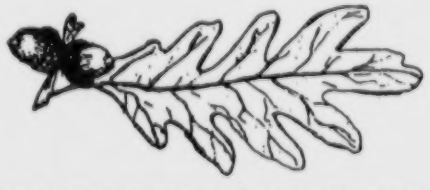
DESIRABLE QUALITIES OF WOOD FLOORING

Wood flooring is widely used for several reasons. Wood has the strength and durability to resist wear. It is also selected for flooring because it offers low heat conductivity, cost of maintenance, and a beautiful appearance. The grain structure, texture and color of wood flooring can be made to blend and compliment the surroundings.

WOODS USED FOR FLOORING

The two major types of wood are grouped according to the two major classifications of trees. Softwood comes from "conifers"; cone-bearing trees with needle-like leaves; often called evergreens. Hardwood is produced from deciduous trees; broad-leaf trees which shed their leaves seasonally. The names' hardwood and softwood do not indicate a degree of hardness, but a general classification.

PINE CONIFER SOFTWOOD



OAK DECIDUOUS HARDWOOD

NATIVE SAMPLES:	
Softwood	**Hardwood**
Pine (all types)	Oak (all types)
Douglas Fir	Ash
Western Larch	Birch
Hemlock	Maple
Spruce	Hickory
Redwood	Walnut
Cypress	Pecan
Western Cedar	Beech

Oak and maple are the popular hardwoods, but beech, birch and pecan are also used for wood flooring. Southern Pine and Douglas Fir are the most popular softwood used as well as Western Hemlock, Ponderosa Pine, Redwood, and Cypress for wood flooring. Softwoods are fairly durable when cut to produce an edge-grain surface.

TYPES OF FLOORING

There are three general types of wood flooring used in today's construction, they are:

1. **Strips** are random length pieces of lumber cut into narrow strips (3 1/4" and less). Strip flooring is tongue and grooved (side-and-end matched) on both ends and sides. The matched ends and side allow for a tight fit of all joints and blind nailing to conceal nail and screws used as fasteners. Generally the top face of the strip is narrower than the bottom face to allow a tight fit at the top and produces a smooth surface. Strip flooring is undercut on the bottom face to allow it to lay flat and stable if the subfloor contains slight irregularities. Strip flooring is also available with square edges and ends which must be faced nailed.

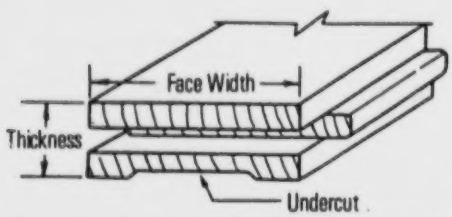


Fig. 14-3 Strip Flooring With Tongue-and-Groove Construction

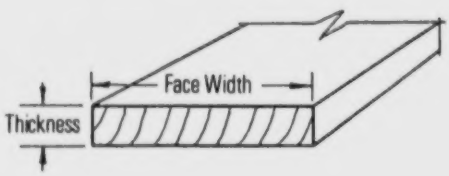


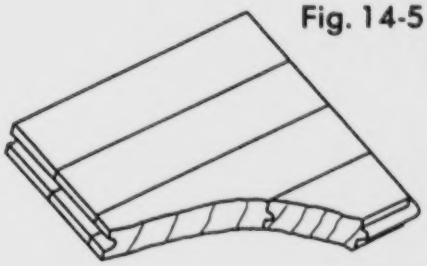
Fig. 14-4 Square Edge Strip Flooring

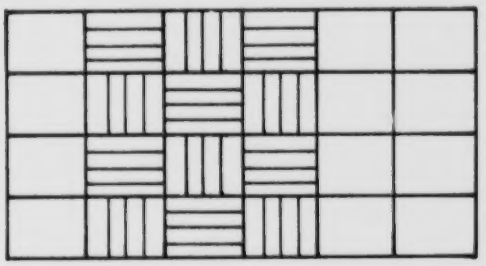
2. **Planks** are very similar to strips except that they are generally wider than 3 1/4". Plank flooring is laid in random widths and lengths. Most plank floors are made of red or white oak and are tongue and grooved like strips. Plank flooring is bored and plugged with wooden plugs of contrasting colors to simulate wooden pegs that originally fastened them in place. This type of

flooring was very popular in the colonial period. Plank flooring is laid in about the same manner as strips flooring.

3. Boards are made in two basic types. Unit blocks are made of pieces of strip flooring glued together edgewise to form a square unit. Laminated or plywood blocks have three or more plys bonded together to form a square unit. The blocks are laid with the grains of each block at right angles of the surrounding blocks. Block flooring is tongue and grooved and is laid in mastic or nailed to a subfloor.

Fig. 14-5 Unit Block





GRADES AND SIZES

Uniform grades are established by the manufacturers of wood flooring and the U.S. Bureau of Standards. Grading by the National Oak Flooring Manufacturers' Association or the Maple Flooring Manufacturers' Association are primarily based on appearance. Other considerations in grading may or may not be are: Knots, wormholes, color, streaks, and percentage of long and short pieces per bundle.

Oak is classified into two grades of quarter-sawed lumber and five grades of plain-sawed. Quarter-sawed grades are clear and select. Plain-sawed grades are clear, select, No. 1 common, No. 2 common, and 1 1/4 foot shorts.

All grades of oak flooring are made in the following combinations of thickness and width:

25/32 - inch thickness, 3 1/4-, 2 1/4-, 2-, 1 1/2-inch widths
3/8- and 1/2- inch thickness, 2- and 1 1/2-inch widths

TABLE 1 -- Grade, description, and dimensions[1] of oak flooring[2]

Kind of Flooring	GRADE		Standard Length
	NAME	DESCRIPTION	
Quartersawed	Clear	The face shall be practically clear, admitting an average of 3/8" of bright sap. The question of color shall not be considered.	2 & up; av., 4 1/4.
Do	Select	The face may contain burls, small streaks, pinworm holes, slight imperfections in working, and small tight knots that do not average more than 1 to every 3 feet.	2 & up; av., 3 3/4.
Plainsawed	Clear	The face shall be practically clear, admitting an average of 3/8" of bright sap. The question of color shall not be considered.	2 & up; av., 4 1/4.
Do	Select	The face may contain burls, small streaks, pinworm holes, slight imperfections in working, and small tight knots that do not average more than 1 to every 3 feet.	2 & up; av., 3 3/4.
Do	No. 1 Common	Shall be of such nature as will lay a good residential floor and may contain varying wood characteristics, such as flags, heavy streaks and checks, wormholes, knots, and minor imperfections in working.	2 & up; av.,

Maple flooring is graded; first grade; second grade; selected first grade, light Northern Hard Maple; selected first grade, Amber Northern Hard Maple; and selected first grade, Red. All grades of maple flooring are made in the following combinations of thickness and width:

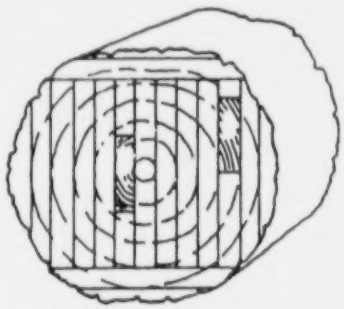
25/32 - inch thickness, 3 1/4-, 2 1/4-, 2-, and 1 1/2-inch widths
3/8-, 1/2-, and 5/8-inch thickness, 2 1/4-, 2-, and 1 1/2-inch widths

TABLE 2 -- Grades, description, and dimensions[1] of northern hard maple, beech, and birch flooring[2]

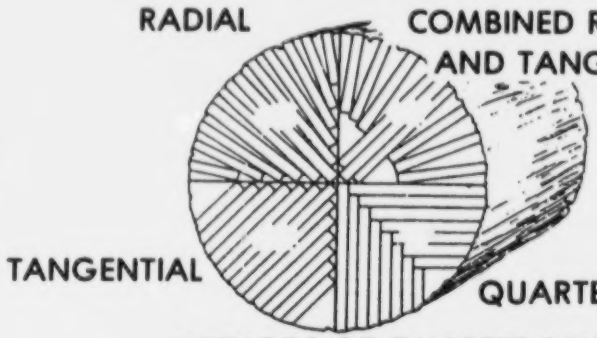
Kind of Wood	GRADE		Standard Length (feet)
	NAME	DESCRIPTION	
Beech, birch, & maple	First grade	Shall have the face practically free from all defects, but the varying natural color of the wood shall not be considered a defect.	2 & up. Not over 30% under 4 feet.
Do	Second grade	Will admit tight sound knots and slight imperfections in dressing, but must lay without waste.	2 & up. Not over 45% under 4 feet.
Maple	Selected first grade light northern hard maple[3]	Special stock selected for uniformity of color. It is almost ivory white and is the finest grade.	2 & up. Not over 30% under 4 feet.
Do	Selected first grade amber northern hard maple[3]	Special stock selected for uniform brown color. It has more grain pattern than other types.	Do.
Beech and birch	Selected first Grade, red[3]	Made from all-red-faced stock especially selected for color.	Do.

The two major methods of sawing logs into lumber is plain-sawed and quarter-sawed. Most lumber today is plain-sawed; also called slab-sawed, slash sawed, and flat sawed (colloquialisms).

Plain-sawed lumber is cut parallel to the side of the log after the log has been squared and generally cuts the annual rings at an angle less than 45^0 exposing more of the hard grain on the lumber surfaces. This is a common method of sawing framing lumber as it is quicker and produces less waste per log.



PLAIN-SAWED LOG



METHODS OF QUARTER-SAWING

Quarter-sawed lumber is cut to produce an angle greater than 45^{0} with the annual growth rings. This produces lumber that is more dimensionally stable and less apt to warp but requires more time, as the sawyer must turn the log with each cut, and produces more waste. This method of sawing is generally used to produce quality hardwood lumber from each log.

Planks are usually 25/32" thick and widths range from 3" to 9" in multiples of 1". Unit blocks are commonly produced in 25/32" thicknesses. The width and length of the unit block are multiples of the width of the strips they are constructed from. Squares constructed from 2 1/4" strips will be 6 3/4" x 6 3/4", 9" x 9", or 11 1/4" x 11 1/4".

ESTIMATING MATERIALS

When determining the amount of wood flooring for the job, first figure the area in square feet for the floor. The formula for figuring area is:

Width in feet x Length in feet = Area in square feet

Example: A floor 25' wide and 30' long would require 750 square feet of wood flooring to cover it.

Width x Length or 25' x 30' = 750 sq. ft. (area)

Board feet of strip flooring to purchase for the job is determined by multiplying the area(sq. ft.) by a size percentage factor. The formula is:

Area(sq. ft.) + % factor x Area(sq. ft.) = Board Feet(bd.ft.)

Example: If 25/32" x 1 1/2" sized wood flooring is used, 55% more material will be required for the 25' x 30' room or 1163 bd. ft.

Area + %factor x Area or 750 +.55 x 750 = 1163 bd. ft.

55% for .....25/32" x 1 1/2"
42 1/2% for .....25/32" x 2"
38-1/3% for.....25/32" x 2 1/4"
29% for .....25/32" x 3 1/4"
38-1/3% for ..... 3/8" x 1 1/2"
30% for ..... 3/8" x 2"
38-1/3% for ..... 1/2" x 1 1/2"
30% for ..... 1/2" x 2"

Fig. 15-10. Percentage added to total area (square feet) to calculate number of board feet of flooring required.

The number of bundles of wood strips are determined by dividing the total board feet required by 24 bd. ft./bundle.

Example: Forty-nine bundles of 25/32" x 1 1/2" strip flooring will have to be purchased for the 25' x 30' room.

Total bd. ft. or 1163 bd. ft. 24 bd. ft per bundle = 49 bundles

Plank flooring quantities are figured similar to strip flooring. Block flooring is packaged in boxes containing 25 sq. ft.

METHODS OF INSTALLATION

Manufacturers recommend that wood flooring be "conditioned" on-site four or five days prior to its installation. This allows the moisture content of the flooring to equalize with the environment of the building or room.

Strip flooring can be nailed directly to subflooring or installed over concrete slabs with the use of sleeper strips. When nailed directly to the subflooring, make certain that the subfloor is clean and contains only slight irregularities. Cover the subfloor with 15-pound asphalt-saturated building paper with a 4" lap on the sides and ends. Snap a chalkline over the center of each floor joist to aid in nailing the flooring to the floor joist. This procedure is very important if plywood is used for subflooring.

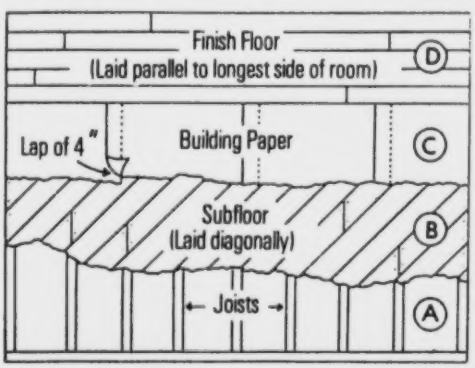


Fig. 14-7 Cutaway View of Floor, Showing Details of Construction: *(a) Joists, (b) Subfloor, (c) Building Paper, (d) Finish Floor*

Strip flooring should be laid across (right angle) the floor joists. Begin laying strip flooring along either sidewall. The first course is very important and should be carefully installed. Set the first course with a chalkline and leave at least a 1/2" expansion joint between the wall and flooring. The expansion will be covered by molding later. Turn the grooved edge of the first strip next to the wall and face nail it . Face nailing will require that the nail head be set and concealed with the use of putty.

The next course of flooring is blind nailed with the nail penetrating the flooring strip where the tongue joins the shoulder. The nail is driven at a 45^0 or 50^0 angle. If a hammer is used for driving the nail, use a nail set to set the nail and prevent possible damage to the edge of the strip.

Cut and fit a number of pieces, using different lengths and install in the same manner as the second course. Begin each course with the pieces cut from the end of a course. Don't permit end joints in adjacent courses to come closer than 6" of each other. Remember to consult the manufacturer's recommendation when selecting type, size, and spacing of nails for strip wood flooring.

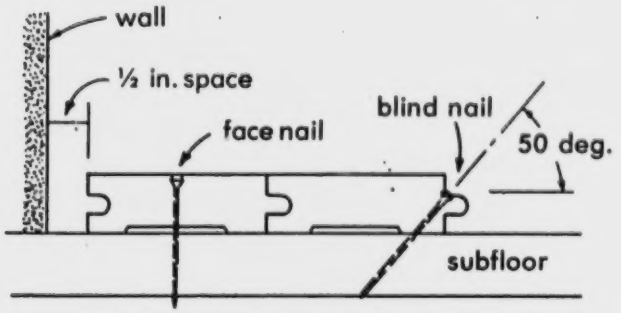


Fig. 15-6. Nailing starter strip.

TONGUED-AND-GROOVED FLOORING. TO BE BLIND-NAILED.	
Flooring Dimen., In.	*Type, Size, Spacing of Nails*
25/32 x 3-1/4 25/32 x 2-1/4 25/32 x 1-1/2	7d or 8d screw type or cut steel nail.* 10-12 in. apart.
1/2 x 2 1/2 x 1-1/2	5d screw type or cut steel or wire nail. 10 in. apart.
3/8 x 2 3/8 x 1-1/2	Bright casing nail--4d wire or cut nail, or screw nail. 8 in. apart. Wood subfloor required.
SQUARE-EDGE FLOORING. FACE-NAILED.	
5/16 x 2 5/16 x 1-1/2	1 in. 15 gauge fully barbed flooring brad, preferably cement coated. 2 nails every 7 in. Wood subfloor required.

NAIL CHART

Strip flooring can be installed over a concrete slab if sleepers are attached or embedded in the concrete surface. The sleeper is a strip of wood (2 x 4 or 1 x 2) to which the wood flooring is nailed.

To install strip flooring over a concrete slab, first clean the floor and then snap chalklines 16" apart. Apply the recommended amount and type of mastic along the chalklines. Place the 1" x 2" sleepers over the mastic and nail in place using 1 1/2" concrete nails spaced 16" to 24" apart. After all sleepers have been installed, cover then with a moisture barrier of 4 mil polyethylene film. Over lap all joints 4". Place another sleeper over the polyethylene film and nail the top sleeper to the bottom sleeper with 4d nails spaced 16" to 24" apart.

To lay strip flooring over the sleepers, follow the same procedure used in installing strip flooring over floor joists and subflooring. While installing strip flooring, don't allow two adjacent strips to join and produce a joint in the same space between sleepers. A weak spot will be produced if this is allowed to happen.

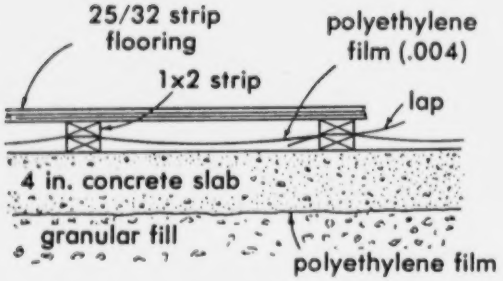


Fig. 15-12. Strip floor system over concrete slab. Sleepers consist of doubled 1 x 2 in. strips.

Plank flooring material is installed following the same procedure used in installing strip flooring. Basically the only difference is the installation of contrasting colored plugs to simulate wooden pegs originally used to fasten them in place. Plank floors are very popular and appropriate for colonial and ranch style homes.

Block flooring is tongue and grooved and may be nailed in place over subflooring like strips and planks. It can also be laid in a special mastic for block flooring. When laid in mastic, a thin coat is applied over the floor which must be relatively smooth, level, and dry. Then a layer of 30 lb. asphalt saturated building paper is place over the mastic. Locate the center of the room and snap two chalklines. A second coat (3/32" thick) is applied over the building paper to cover about one-quarter of the space, don't cover the chalkline.

Begin laying the blocks in the center of the room using the chalkline as a guide. Take time to position each block correctly. Continue laying blocks to the sidewalls and leave about a 1" expansion joint between the end of the block and wall. This joint will be covered with molding later. Apply mastic to another quarter of the room and continue until entire floor is covered. Remember to follow the manufacturer's instruction on installation of block flooring and mastic to secure the desired end results.

RELATED SAFETY

Safety of the worker is of utmost concern. Correct clothing and proper safety apparel should be worn at all times. When nailing wood flooring, proper eye protection should be worn at all times. Always select and use the correct tool safely for the job.

Remember to always READ and FOLLOW the manufacturer's instructions regarding their products.

ASSIGNMENT SHEET
ON
WOOD FLOORING

VIII-C-1(AS)
KEY

SUBJECT: Materials Calculations

AIM: To develop the students' ability to calculate the amount of flooring material required and determine the cost.

INTRODUCTORY INFORMATION:

Wood flooring material is manufactured in three basic types: strips, planks, and blocks. To determine the quantity of materials, the area in square feet and/or board feet of wood flooring must be figured. The formulas are:

Area(square feet) = Width in feet x Length in feet

Board Feet = Area(sq. ft.) + %factor x Area(sq. ft.)

After the amount of wood flooring (bd. ft. or sq. ft.) have been determined, the cost is determined by multiplying the cost per unit times the total number of units.

Example: 1/2" x 2 1/2" strip flooring cost $54.50/bundle. How much would 52 bundles cost?

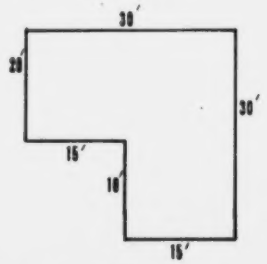
52 x $54.50/bundle = $2,834.00

REFERENCE:

Wagner, Willis H., Modern Carpentry, Unit 15

QUESTIONS AND PROBLEMS:

1. Determine the square feet in the following:
   a. A dining room 15' wide and 18' long — 27 sq. ft.
   b. A living room 18' wide and 24' long — 432 sq. ft.
   c. A den 20' wide and 25' long — 500 sq. ft.
   d. Dining and den combination as follows: — 750 sq. ft.



2. Determine the board feet in the following:
   a. A den 16' wide and 18' long, 42 1/2% size factor — 411 bd. ft.
   b. A living room 20' wide and 22' long, 55% size factor — 682 bd. ft.
   c. A dining room 15' wide and 16' long, 30% size factor — 312 bd. ft.
   d. A breakfast room 10' wide and 13' long, 29% size factor — 168 bd. ft.

3. Determine the number of bundles (24 bd. ft.) required in the following:
   a. 411 bd. ft. — 18
   b. 682 bd. ft. — 29
   c. 312 bd. ft. — 13
   d. 168 bd. ft. — 7

4. Determine the cost if a bundle costs $54.50/bundle:
   a. 18 bundles — $981.00
   b. 29 bundles — $1,580.50
   c. 13 bundles — $708.50
   d. 7 bundles — $381.50

5. Determine the number of boxes of block flooring required in the following if one box contains 25 sq. ft.:
   a. A den 24' wide and 26' long — 25
   b. A living room 16' wide and 20' long — 13
   c. A family room 25' wide and 30' long — 30
   d. A kitchen 14' wide and 15' long — 9

INSTRUCTOR'S PLAN
MANIPULATIVE LESSON

VIII-C-1(S)

TASK: Install Wood Finish Flooring

AIM: The student will be able to correctly install wood finish flooring

TOOLS AND EQUIPMENT: Measuring tape, framing square, chalkline, hammer, nail set, hand or power portable nailer, power saw, crosscut saw, caulking gun, sawhorses, pencil, safety equipment, notched trowel

MATERIALS: As per details and specifications - wood flooring material, nails, mastic, building paper, polyethylene vapor barrier, sleeper lumber

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 15

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must have successfully completed related lesson and assignment sheet, VIII-C-1(I) AND VIII-C-1(AS)

CHECKING STANDARDS:
1. Accuracy in selection of materials
2. Accuracy of material estimations
3. Squareness of room
4. Maintains safe work habits

I. PREPARATION (OF THE LEARNER - MOTIVATION)

When wood flooring is installed, it is a fixed and relatively permanent part of the home, therefore, it is very important to select quality material and install it correctly. Wood flooring such as oak and maple have the strength and durability to last for many years and justifies the initial cost of the materials and installation. The manufacturer's instructions and recommenda-tions should be followed at all times.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Select Material	1. As per builder's plan 2. Manufacturer's recommendation 3. Check condition of material, return damaged for replacement
2. Preparation of Materials	1. Condition wood flooring to room moisture content four to five days prior to installation 2. Layout material and arrange for most pleasing color and grain patterns
3. Wood Strip Flooring Installed on Subflooring	
A. Preparation	1. Check squareness of room

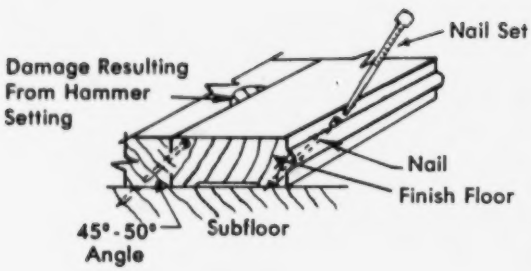
2. Check subfloor, complete nailing patterns and set properly
3. Clean subfloor of dirt and foreign material
4. Arrange strips for most pleasing appearance and random joints
5. Cover subfloor with 15 lb. asphalt saturated building paper; insure a 4" side and end laps

NOTE: It is recommended to use double-weight paper when subfloor is located directly over heating ducts

6. Snap chalkline over center of each floor joists
7. Snap chalkline locating first course of flooring parallel to sidewall

NOTE: Allow an additional 1/2" for expansion joint between strip and wall

B. Installation



1. Align first strip on chalkline with grooved edge toward wall and face nail, close enough to cover nail by the molding

NOTE: Strips should be laid across (right angle) flooring joists

2. Blind nail tongue edge, 8d nail for 25/32" thickness, 5d for 1/2" thickness, or 4d for 3/8" thickness

NOTE: Drive nail at 45^{0} to 50^{0} angle, careful not to damage edge of flooring. Use nail set to finish driving nail

3. Position second course, fit tightly and stagger joints of end matched flooring

NOTE: Don't allow end joints of adjoining strips to come closer than 6" to each other

4. Blind nail tongue edge, 10"-12" apart, portable hand or power nailers are sometimes used
5. Proceed laying courses in similar manner, leave 1/2" expansion joint at the beginning and end of course

NOTE: Pieces cut from the end of a course are used to begin the next course, cut end toward the wall

6. Check measurement of space when flooring has been laid within 2' or 3' of wall to insure flooring is parallel to wall

NOTE: This is necessary so that the last piece of flooring appears aligned with molding

7. If not parallel, dress grooved edge of succeeding courses slightly to bring final course parallel with wall

4. Wood Strip Flooring Installed on Concrete Slab

A. Preparation

1. Clean slab of dirt and foreign material
2. Snap chalklines 16" apart run 90° from finished floor
3. Per manufacturer's recommendations, apply mastic on/over chalklines

Example: Some manufacturers recommend a band the width of the sleeper, others a river (large bead) of mastic

4. Place 1" x 2" sleepers over mastic and nail in place with 1 1/2" concrete nails

NOTE: Wear proper eye protection when nailing all types of nails. Especially hardened nails, like concrete nails

5. Install 4 mil polyethylene vapor barrier, over lap per manufacturer's instructions
6. Nail sleeper over polyethylene film with 4d spaced 16" to 24" apart

B. Installation

1. Install strip flooring over sleepers using the same procedure as installing strip flooring over subflooring
2. Follow manufacturer's recommendations
3. Don't allow joints of adjoining (side-by-side) strips to occur between the space of the sleepers

5. Wood Block Flooring

A. Preparation

1. Clean subfloor of dirt and foreign material
2. Locate center of room and snap main center line from wall to wall
3. Snap another center line at right angles to the main one, divides the room into quarters
4. Make a trial layout of blocks along the center lines, adjust center lines if border tiles or too small, 2" or less

B. Installation

1. Nailed in place
   a. Start in center of room, align tongue edge of block with chalklines
   b. Nail in the same manner as strip flooring, blind nail
   c. Exercise care in arrangement, placement and alignment of each block
   d. Cut border blocks to allow for an 1/2" to 1" expansion joint

NOTE: Expansion joint will be covered with molding

2. Placed in mastic
   a. Spread mastic over one-quarter of the space, don't cover chalkline
   NOTE: Use a notched trowel, since the depth of the notches determine the depth of mastic applied
   b. Start in center of room and lay first course of blocks using chalkline as guide
   c. Continue laying blocks to the wall exercising care in arrangement, placement and alignment of each block
   d. Cut border blocks to allow for an 1/2" to 1" expansion joint
   NOTE: Expansion joints will be covered by molding
   e. Apply mastic to another portion of room and continue laying wood blocks

IMPORTANT POINT: Manufacturers' may require a layer of 30 lb. building paper to be placed over subflooring. Follow manufacturer's instructions

III. APPLICATION (PRACTICE BY THE LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates correct installation of strip or plank flooring
Instructor: Demonstrates correct installation of block flooring using nails or mastic
Instructor: Passout job and task sheets
Student: Practice job and tasks under supervision of instructor

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Student installs wood flooring types per building plans, specifications, and manufacturer's recommendations.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

To insure long life and beauty of wood finish flooring, proper construction practices, correct installation, and selection of the right materials must be followed. The manufacturer's recommendations and instructions should be followed with a minimum of variations. There is no substitute for quality of work.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 15

THE NEXT LESSON IS: VIII-C-2(S) "Finishing Wood Floors"

JOB SHEET
ON
WOOD FLOORING

VIII-C-1(J)

NAME OF JOB: Install Wood Flooring

DRAWINGS: Builder's plans, elevations and details

MATERIALS: As per specifications and details - wood flooring materials, nails, mastic, building paper, polyethylene vapor barrier, sleeper lumber

TOOLS AND EQUIPMENT: Measuring tape, framing square, chalkline, hammer, nail set, hand or power portable nailer, power or hand saw, sawhorses, pencil, notched trowel, safety equipment

GENERAL INSTRUCTIONS: Study the plans and specifications. Determine wood flooring type and quantities best suited for job. Determine and cut material to allow for a 1/2" to 1" expansion joint.

Attach directly to subfloor or sleeper as required. Use vapor barrier with sleepers if required. Fit flooring tightly to give a smooth surface. Blink nail tongue and grooved and be careful setting nail so as not to damage edge of flooring material.

Mastic should be used as instructed by manufacturer. Use building paper with mastic if so specified.

Observe all safety rules and regulations. Wear proper eye protection and safety apparel for the job. Use the correct tool for the job and safely. Think safety at all times. Watch out for others when nailing.

PROCEDURES AND/OR TASKS:
VIII-C-1(TS) Install Wood Strip Flooring Directly to Subfloor
VIII-C-1a(TS) Install Wood Strip Flooring Over Concrete Slab
VIII-C-1b(TS) Install Wood Block Flooring

TASK: Install Strip Flooring Directly to Subflooring

JOB: Install Wood Flooring

TRADE: Building Trades

TOOLS AND MATERIALS: Wood flooring per builder's plans, nails, measuring tape, framing square, chalkline, hammer, nail set, hand or power nailer, power or hand saw, sawhorses, pencil, safety equipment

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Builder's Plans	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Select Materials	1. Size (width, random lengths, thickness) as per builder's plan 2. Nail type and size, screws, other fasteners 3. Match color and grain patterns
3. Preparation of Material	1. Check squareness of room 2. Check subfloor, complete nailing patterns and set properly 3. Clean surface of dirt and foreign material 4. Arrange strips for most pleasing appearance and random joints 5. Cover subfloor with 15 lb. asphalt saturated building paper; insure a 4" side and end lap NOTE: It is recommended to use double-weight paper when subfloor is located directly over heating ducts 6. Snap chalkline over center of each floor joists 7. Snap chalkline locating first course of flooring parallel to sidewall NOTE: Allow an additional 1/2" for expansion joint between strip and wall
4. Installation	1. Align first strip on chalkline with groove edge toward wall and face nail, close enough to cover nailhead by the molding NOTE: Strips should be laid across (right angle) flooring joists 2. Blind nail tongue edge, 8d nail for 25/32" thickness, 5d for 1/2" thickness, or 4d for 3/8" thickness

STEPS	KEY POINTS
	NOTE: Drive nail at 45° to 50° angle, careful not to damage edge of flooring. Use nail set to finish driving nail
	3. Position second course, fit tightly and stagger joints of end matched flooring
	NOTE: Don't allow end joints of adjoining strips to come closer than 6" to each other
	4. Blind nail tongue edge, 10" to 12" apart, portable hand or power nailers are sometimes used
	5. Proceed laying courses in similar manner, leave 1/2" expansion joint at the beginning and end of course
	NOTE: Pieces cut from the end of a course are used to begin the next course, cut end toward the wall
	6. Check measurement of space when flooring has been laid within 2' or 3' of wall to insure flooring is parallel to wall
	NOTE: This is necessary so that the last piece of flooring appears aligned with molding
	7. If not parallel, dress grooved edge of succeeding courses slightly to bring final course parallel with wall

TASK: Install Strip Flooring Over Concrete Slab

JOB: Install Wood Flooring

TRADE: Building Trades

TOOLS AND MATERIALS: Wood flooring per builder's plans, nails, mastic, building paper, polyethylene vapor barrier, sleeper material, measuring tape, framing square, chalkline, hammer, nail set, hand or power nailer, power or hand saw, caulking gun, sawhorses, pencil, notched trowel, safety equipment

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Builder's Plans	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Select Materials	1. Size (width, random lengths, thickness) per builder's plan 2. Nail types and sizes, screws, mastic, other fasteners 3. Polyethylene film and sleeper material per builder's plan 4. Mastic recommended by manufacturer 5. Match color and grain patterns
3. Preparation of Material	1. Clean slab of dirt and foreign material 2. Snap chalklines 16" apart, run 90^{0} from finished floor 3. Per manufacturer's recommendations, apply mastic on/over chalklines Example: Some manufacturers recommend a band the width of sleeper, others a river (large bead) of mastic 4. Place 1" x 2" sleepers over mastic and nail in place with 1 1/2" concrete nails NOTE: Wear proper eye protection when nailing all types of nails. Especially hardened nails like concrete nails 5. Install 4 mil polyethylene vapor barrier, overlap per manufacturer's instructions, generally 4" to 8" 6. Nail sleeper over polyethylene film with 4d nails spaced 16" to 24" apart
4. Installation	1. Install strip flooring over sleepers using the same procedure as installing strip flooring over subflooring 2. Follow manufacturer's recommendations

STEPS	KEY POINTS
	3. Don't allow joints of adjoining (side--by-side) strips to occur between the space of the sleepers

TASK: Install Block Flooring

JOB: Install Wood Flooring

TRADE: Building Trades

TOOLS AND MATERIALS: Wood per builder's plans, nails, mastic, building paper, measuring tape, framing square, chalkline, hammer, nail set, hand or portable nailer, power or hand saw, pencil, notched trowel, safety equipment

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Builder's Plans	1. Determine amount of materials, type and quantities 2. Familiarize self with details and dimensions
2. Select Materials	1. Size of squares and thickness according to building plans 2. Nail types and sizes, screws, mastic, other fasteners 3. Building paper if manufacturer requires it 4. Mastic recommended by manufacturer 5. Match color and grain patterns
3. Preparation of Material	1. Clean subfloor of dirt and foreign material 2. Locate center of room and snap main center line from wall to wall 3. Snap another center line at right angles to the main one, divides the room into quarters 4. Make a trial layout of blocks along the center lines, adjust center lines if border tiles are too small, 2" or less
4. Installation	1. Nailed in place a. Start in center of room, align tongue edge of block with chalkline b. Nail in same manner as strip flooring, blind nail c. Exercise care in arrangement, placement and alignment of each block d. Cut border blocks to allow for an 1/2" to 1" expansion joint NOTE: Expansion joint will be covered with molding 2. Placed in mastic a. Spread mastic over one-quarter of the space, don't cover chalkline

STEPS	KEY POINTS
	NOTE: Use a notched trowel, since the depth of the notches determine the depth of mastic applied b. Start in center of room and lay first course of blocks using chalkline as guide c. Continue laying blocks to the wall exercising care in arrangement, placement and alignment of each block d. Cut border blocks to allow for an 1/2" to 1" expansion joint NOTE: Expansion joint will be covered with molding e. Apply mastic to another portion of room and continue laying wood blocks IMPORTANT POINT: Manufactureres may require a layer of 30 lb. building paper to be placed over subflooring. Follow manufacturer's instructions

INSTRUCTOR'S PLAN VIII-C-2(I)
INFORMATIONAL LESSON

SUBJECT: Finish Wood Flooring

AIM: The student will be able to prepare wood flooring to receive a protective floor finish and apply the finish to the floor surface according to builder's plans and manufacturer's recommendations.

TEACHING AIDS: Information Sheet VIII-C-2(IS), chalkboard/chalk

MATERIALS: Samples of sandpaper, filler, stains, resinous coatings, paint brushes, spray guns

REFERENCES: Soderberg, George A., Finishing Technology, Chapters 1, 2, 6, 10, 12, 14, 15
Wagner, Willis H., Modern Woodworking, Unit 9, 10

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must exhibit a sincere interest in building trades and meet the requirements of the Texas Education Agency and local school district.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Hardwoods and softwoods selected for finished flooring must have hard, dense surfaces to withstand heavy wear and abrasion. These types of finished floors are quite an investment to the home owner and must be protected to insure a long life.

Wood flooring requires a protective coating such as a filler, sealer, varnish, lacquer, shellac, or wax. Finishing therefore, is defined as the process of coating or treating a floor for the purpose of protecting and/or decorating it.

The final finish of wood floor is a very important step, yet many times too little emphasis is placed on this important step. Careful consideration should be given to the finish of the wood flooring to insure lasting beauty and serviceability of the floor.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTORS TO DO OR SAY
A. Scope of Floor Finishing Passout: VIII-C-2(IS)	1. Surface preparation - the condition of the surface determines to a great degree the life of the finish a. Sanding - always with the grain b. Filling - required on open-grain woods for a smooth surface finish 2. Finishing - for the purpose of protecting and/or decorating a. Staining - emphasize or deemphasize the grain and adds color to wood surface b. Final finish - generally clear to show the natural beauty of the wood floor

3. Finisher
   a. Painter - competence is achieved through apprenticeship training, helper or handyman
   b. Employment
   c. Working conditions

B. Surface Preparation

(Show Examples)

1. Classes of abrasive
   a. Natural
      1) Flint
      2) Garnet
   b. Manufactured (synthetic)
      1) Aluminum oxide
      2) Silicon carbide
2. Grade (size)
3. Coated abrasives (sandpaper)
   a. Forms
      1) Sheet
      2) Drums
      3) Discs
      4) Belts
   b. Types of backing
      1) Paper
      2) Cloth
      3) Fiber
      4) Combination
   c. Types of bonding - two layers, bond and size coat
      1) Glue
      2) Glue and filler
      3) Resin over glue
      4) Resin over resin
      5) Waterproof
4. Sanding procedures
   a. Sanders and sanding equipment
   b. Use and operation
   c. Care and maintenance

C. Fillers

1. Purpose and function
2. Types or forms
   a. Liquid
   b. Paste
3. Application of filler

D. Stains

1. Types
   a. Water - deep penetration
   b. Oil
      1) Penetrating - easy to apply
      2) Pigmented - used extensively in furniture finishing
   c. Spirit - touch-up work
   d. Nongrain-raising (NGR) - most recently developed

2. Application
   a. Sprayed
   b. Brushed

E. Sealers

1. Purpose - ties down stain and filler and prevents absorption of the finished coat into the wood
2. Types
   a. Shellac - smoothed with steelwool
   b. Lacquer base - sanding sealer
   c. Oil-base
3. Penetrating sealers are used extensively for finishing floors

F. Resinous Coatings

(Show Examples)

1. Basic types
   a. Oleoresinous varnish
   b. Synthetic varnish
   c. Lacquer varnish
   e. Shellac varnish
2. Composition and characteristics of different resinous coatings
3. Qualities and basic uses
4. Application methods
   a. Brushing
   b. Spraying
   c. Roller

(Show different brushes used)

5. Equipment care and use

G. Safety

1. Clothing and apparel
   a. Eye protection
   b. Respirators and filter masks
   c. Gloves
2. Handling, storage of volatile material
3. Ventilation
4. Follow manufacturer's instructions for safe use of their product

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

Discuss with the student(s) the purpose of the finishing procedures of wood flooring.
Discuss with the student(s) the proper use of power equipment for sanding wood flooring.
Discuss with the student(s) the resinous finishes available today for wood floors.
Take a field trip with student(s) to construction a site and observe the finishing of wood floors.
Review what was observed on the construction site with the student(s).

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS.)

Simple Recall

1. Softwoods and _____ are selected for finished flooring because they can withstand heavy wear and abrasion.	hardwoods
2. When sanding, always sand _____ the grain of the wood.	with
3. Floors are finished to _____ and decorate them.	protect
4. Open-grained woods like oak, must be _____ before the final finish is applied.	filled
5. Color is added to wood flooring and the grain emphasized by the use of _____.	stains
6. Flint and garnet are examples of _____ abrasives.	natural
7. Aluminum oxide and _____ are synthetic or manufactured abrasives.	silicon carbide
8. Paper, cloth, fiber and combinations of these are used for _____ backing on coated abrasives.	backing
9. Coated abrasives have a bond, or adhesive, that locks the abrasive to the backing and there is _____ bonding layers.	two
10. A _____ coating is a finishing material which contains a resin and a vehicle.	resinous

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

Wood flooring requires a protective coating of such things as: fillers, sealers, varnishes, lacquers, shellacs, and/or wax. Finishing is the process of coating or treating a floor for the purpose of protecting and/or decorating it.

The correctness of surface preparation determines, to a great degree, the life of the finish. The correct selection and use of coated abrasives (sandpaper), fillers, stains, sealers, resinous coatings, and equipment are very important.

Aluminum oxide coated abrasives in the belt and disc form are commonly used for sanding wood floors. Care should be taken when operating power sanders. The floors must be cleaned very good before finishing occurs.

Since the person finishing wood floors is working with power tools and volatile materials, safety is a must. Be sure rooms are properly ventilated. Follow manufacturer's instructions very closely.

SUGGESTED READING FOR STUDENTS:

Finishing Technology, Chapters 1, 2, 6, 10, 12, 14, 15
Modern Woodworking, Unit 9, 10

THE NEXT LESSON IS: VIII-C-3(I) "Resilient Tile Floor"

INFORMATION SHEET VIII-C-2(IS)
ON
FINISH FLOORING

SUBJECT: Finish Wood Flooring

INTRODUCTORY INFORMATION:

To protect the beauty and life of hardwood and softwood floors, careful attention must be given to the finishing operation. Finishing is defined as the process of coating or treating a floor for the purpose of protecting and/or decorating it. Appearance of some woods may not be enhanced by finishing because of natural beauty, but these unprotected floors lose their beauty through abrasion or contact with the elements. Therefore, without exception, finishing of the wood flooring is very important.

Too often the final finishing operation is considered secondary. Care should be taken on the student(s) part in the surface preparation and the selection of fillers, stains, sealers and resinous coatings.

GENERAL INFORMATION:

SCOPE OF FLOOR FINISHING

Great emphasis must be place upon the importance of surface preparation. This should be job number one in the worker. Time and money are well spent and returned with interest in the form of longer life and lower maintenance costs. Finishing of wood flooring may or may not involve the following operations:

1. **Sanding** is the process where wood fibers are cut with an abrasive that smooths the wood surface and prepares it for finishing coats. Heavy-duty disc sanders and belt-type floor sanders are used in the sanding of wood floors. Since most resinous coatings are transparent (clear), sanding should be done in the direction that the grain of the wood runs.

2. **Filling** is required on open-grain wood like oak to fill the pores. This provides a smooth surface finish.

3. **Staining** emphasizes or de-emphasizes the grain and will add color to the wood surface. Stain is not always a requirement in finishing wood flooring. Many woods have greater beauty finished naturally using a transparent (clear) finish coating.

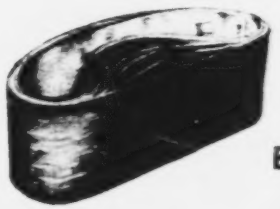
4. **Sealing** coats ties down the stain and filler already applied and prevents absorption of the finished resinous coat into the wood. A closed-grain wood requires a sealer to close the porous surface, thus eliminating the need for a filler.

5. **Final finish** is generally a clear resinous coating that allows the natural beauty of the wood flooring to show.

SURFACE PREPARATION

Unfinished wood flooring material will need to be sanded before the final coating is applied. Sanding is done with coated abrasives in one of the basic forms: sheets, drums, discs or belts.

SHEETS



BELTS

Coated abrasives (sandpaper) are manufactured by bonding natural and synthetic abrasives on backing materials of paper, cloth, fiber, and combinations of paper and cloth. Natural abrasives used for sanding wood are flint and garnet. Synthetic abrasives are manufactured in electric furnaces and the two most commonly used for sanding wood are aluminum oxide and silicone carbide.

Abrasive materials are crushed and sifted through numbered silk screens that determine the grit size or grade of the abrasive. For example: a fine grade of abrasive is No. 120 for sanding floors. This is sifted through a No. 120 screen which has 120 openings along one side and has a total of 14,400 openings per square inch.

GRAIN TYPES	SILICON CARBIDE	ALUMINUM OXIDE	GARNET	FLINT
EXTRA COARSE	12 16 20	16 20 4 3½	16 20 4 3½	
VERY COARSE	24 30 36	24 30 36 3 2½ 2	24 30 36 3 2½ 2	Extra Coarse
COARSE	40 50	40 50 1½ 1	40 50 1½ 1	Coarse
MEDIUM	60 80 100	60 80 100 ½ 0 2/0	60 80 100 ½ 0 2/0	Medium
FINE	120 150 180	120 150 180 3/0 4/0 5/0	120 150 180 3/0 4/0 5/0	Fine
VERY FINE	220 240 280	220 240 280 6/0 7/0 8/0	220 240 280 6/0 7/0 8/0	Extra Fine
EXTRA FINE	320 360 400 500 600	320 400 9/0 10/0	320 400 9/0 10/0	

ABRASIVE CHART

The abrasives are glued to the backing with the first layer (bond coat) of adhesive. After pre-drying, a second coat (size coat) is applied. The coatings are either closed or open coatings. No adhesive is exposed in the closed type, as

the surface of the backing is completely covered with abrasive. In the open coat, the surface is not completely with abrasive. This space helps the coated abrasive material from filling or loading-up when sanding soft or gummy materials.

Sanding of wood flooring is generally done with belt-type floor sanders and a heavy-duty disc sander. In general, sand with the grain of the wood when finish sanding. Always begin with the finest grit coated abrasive that will do the job. Coarse coated abrasives will scratch, finer coated abrasives are needed for a smooth surface. Select the grade (size) of abrasive according to sanded surface desired.

BELT FLOOR SANDER

HEAVY-DUTY DISC SANDER

Use and care for the power equipment as per manufacturer's instructions. Modern power woodworking equipment can save a lot of time. The equipment must not only be operated correctly, but also safely. Since the floor will receive sealing and finish coats, care should be taken in the removal of dust during and after sanding operations.

FILLERS

Wood fillers are used to fill the pores of open-grain woods to enhance beauty and smoothness of the surface. Wood fillers are available in a liquid or paste form. The type of filler to use depends on the porosity of the wood. Woods such as oak, walnut, mahogany, hickory, and ash require paste fillers because the surface is covered with millions of small open pores. Birch, maple, and cherry woods require liquid fillers. Woods such as pines, fir and poplar are closed-grained and require no filler. A surface sealer is recommended for the closed-grain woods.

Shellacs, and varnishes of low viscosity are commonly used as liquid fillers. Thinned paste filler, however, are more satisfactory for high-quality surface finishes. Selection and application should be according to the manufacturer of the wood flooring material used on the job.

Fillers are usually applied either by brush or spraying. When applying with brush, brush both with and across the grain. Allow the filler to dry until the gloss or sheen disappears. Remove excessive filler with coarse cloth or burlap by rubbing across the grain. Allow to dry 24 hours.

STAINS

A stain is a solution or suspension of coloring matter in a vehicle. Stains are used primarily to produce color rather than a protective cover for wood flooring. Stains can enrich the natural beauty of the wood or color the less desirable woods to imitate the more expensive wood surfaces.

Stains are classified into four major groups according to their solvent or vehicle: water, oil, nongrain-raising, and spirit. Water stains are made of water-soluble dyes. They give the clearest, deepest, and most transparent results of all stains. Water stains also have less tendency to fade or bleed into other coating such as sealers and resinous coatings. Water stains has the tendency to raise the wood grain and must be presponged or a wash coat (7 parts alcohol, 1 part shellac) of shellac applied. Light sanding is required prior to staining. Spraying is the best method of applying water stains.

Oil stains may be either penetrating or pigmented. Penetrating stains are oil-soluble dyes dissolved in oils such as benzol, naphtha, toluol, or turpentine. They are easy to apply and combine readily with woodfillers in making filler stains. Oil stains do not raise the wood grain and because of its inability to penetrate deeply, it is difficult to stain or restain a surface to obtain a dark color in hardwoods.

Pigmented oil (wiping) stains are colors ground in an oil solution with linseed oil or some other varnish vehicle. Their main use is to produce a uniform finish on furniture by wiping and blending of colors. They have little tendency to bleed or fade. Spraying and brushing are common application methods.

Spirit stains are made of aniline dyes soluble in alcohol. They are mainly used for touch-up, repair, and maintenance work on wood floors because the will penetrate old finishing materials. Care should be taken in using spirit stains as they are difficult to apply and may lift with a shellac sealing coat, giving a muddy, unclear effect. Since spirit stains dry and set rapidly, they are generally limited to spray application.

The most recently developed stains are the nongrain-raising (NGR) stains. They have a minimum tendency to raise wood grain while producing the clarity of a water stain. NGR stains, like spirit stains, have short drying periods that do not permit then to penetrate as deeply as water stains. Spray application is generally best for NGR stains.

SEALERS

A sealer coat ties down the stain and filler previously applied. It also prevents absorption of the finish coat into the wood and seals out moisture of surfaces that do not receive additional finishes. A sealer coat is all that is required on closed-grain wood as it will seal the wood and provide a foundation for surface coats.

Sealers used today are shellac and lacquer base sealer (sanding sealers). Shellac is used extensively as a sealer. It dries dust free in about 15 minutes and can be rubbed or recoated in about 2 hours. Shellac is usually smoothed by steelwool because it loads or fills dry coated abrasives.

Lacquer base sealer are best applied by spraying. They dry in about 10 minutes and can be sanded with very fine coated abrasive material in about 30 minutes. It cuts and sands very easily and doesn't load or fill the coated abrasive. It also provides a smooth surface for final finish coats.

Sealers for natural finishes, such as for wood flooring, are available in two types: penetrating or intrasurface and surface. Surface sealers are applied and wear like resinous coating. Penetrating sealers leave no continuous coating on the surface. They penetrate the wood deeply and readily. Because of the deep penetration, sealed floors are similar to inlaid linoleum in that the pattern of finish wears down with the wood. Floors subjected to severe wear or service give very little indication of wear. After light sanding, another coat of sealer can be applied to the worn surface and blend perfectly with the surrounding surface. For these reasons, penetrating shellacs are highly recommended for finishing wood flooring.

RESINOUS COATINGS

A resinous coating is a finishing material which contains a resin and a vehicle. The vehicle (liquid part of paint or varnish) determine if the coating is an oil or spirit varnish. Oil varnishes are essentially solutions of resin in drying oils. Spirit varnishes are solutions of resin in volatile solvents. Resinous coating range in color of film from clear to dark amber, depending on resin used.

The four basic types of resinous coatings are oleoresinous, synthetic, lacquer, and shellac varnish.

Oleoresinous varnishes have been used for centuries. They produce an excellent transparent finish on wood that is durable and hard. Wood floor varnishes are called medium oil varnishes. They contain 12-40 gallons of oil per 100 pounds of resin. It is easy to brush or spray on a perfectly smooth film and it dries for recoating in 24-48 hours.

Synthetic varnishes is created by chemical reaction of comparatively simple compounds. Synthetic resins are synonymous with plastics. These manmade resins were originally given the name "plastics" because they could be shaped or formed. Polyurethane varnish is a very popular synthetic varnish used for floor finishes. It is extremely mar- abrasion- and stain-resistant. It dries rapidly, resulting in less dirt pick-up and faster recoating. Polyurethane varnish retains its gloss and beauty longer than any other type of resinous finish.

Polyurethane can be applied over most sealers and fillers; however, it is usually best to apply it directly to clean dry wood. Overnight drying and light sanding between coats are recommended. Some manufacturer's recommend that additional coats be applied within a 48 hour period.

Wood lacquer varnishes are formulated to produce gloss, semi-gloss and flat finishes. Lacquer varnishes are most commonly used in furniture finishing. Lacquer varnishes are also very difficult to thin correctly because of the number (combinations) of solvents used in the production.

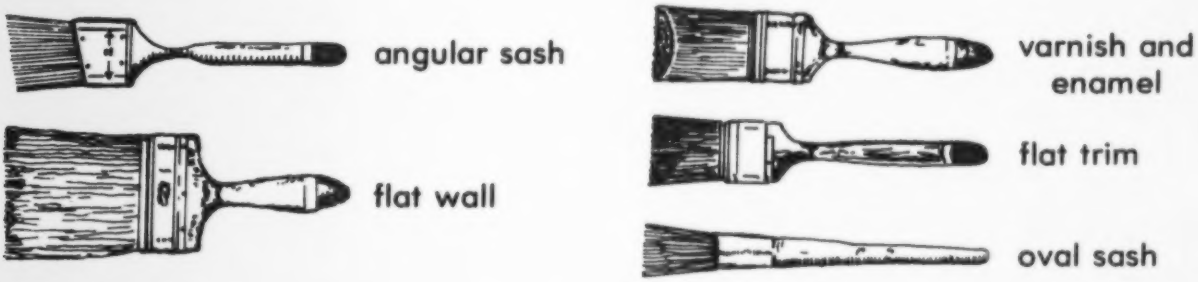
Shellac varnish is produced when lac resin is dissolved in alcohol to form orange shellac. The resin is bleached to produce pure white shellac. One of the most

valuable characteristics of shellac varnish is it can be used as a sealing coat oil for stains and fillers. It is easily applied and dries quickly. Brushing and spraying are the most common methods of application.

METHODS OF APPLICATION

Most floor finishing operations are applied either with a brush or spraying equipment. Regardless which is selected, the selection and use of the applicator are very important.

Brushes are manufactured in many grades, kind, and sizes. Careful attention should be given to the selection of quality brushes for finishing operation. Brushes for many years have been made from hog bristle. Nylon bristles have replaced the hog bristle and are used extensively for brushes. After many years of research and development, nylon brushes have proven superior to the best hog bristle brush. The nylon bristle outwears the hog bristle brush three to five times. Nylon bristle is resistant to paint solvents and water. Its paint-carrying capacity increases with use.



Few brushes are worn out. Most are ruined because of improper use and care. The following are practical suggestions that will extend the life of any paint brush.

1. Always break in a new brush with the vehicle found in the finishing material that is to be applied. This practice will permit easier cleaning of the heel.

2. All new brushes will shed a few bristles. Spin the brush between the palms of the hands to remove these loose filaments.

3. Never dip a brush too deeply; 1/3 to 1/2 the length of the bristles is sufficient.

4. Never use a brush edgewise or draw a brush edgewise across the paint can to remove excess paint; this practice is a common cause of *fingering*.

5. Always use the proper size and type of brush for the job; never use a 3" brush when a 2" brush will do.

6. Never keep paint or varnish brushes in water. The plugs will absorb water, causing the bristles to flare out and become bushy.

7. Never leave a nylon brush in paint and varnish remover, acetone, or lacquer thinner for a long period of time.

8. Never poke or jab a brush into corners, holes, or cracks. To avoid this practice, use the right kind and size of brush.

9. Never leave a brush standing on its bristle ends in a paint pot.

10. Never use a new brush on *paint-starved* old lumber, on rusty steel or iron, or on rough, unpainted concrete floors.

11. Preserve the shape of the brush by turning it in your hand occasionally.

12. Keep brush carefully wrapped in paper when not in use.

All brushes should be thoroughly cleaned immediately after use. The following procedure when properly carried out is excellent for keeping brushes in working condition:

1. Remove all excess finishing material from the brush by wiping it against a wire screen or metal lath.

2. Wash thoroughly in proper solvent. Brushes used in paint, enamels, or oleoresinous varnishes should be washed in turpentine; shellac brushes in alcohol; lacquer brushes in lacquer thinner; and water-thinned paintbrushes in water.

3. Remove excess solvent by spinning brush or by squeezing the bristles between thumb and forefinger.

4. Wash with warm water and a mild soap. Continue until a clean white lather is developed.

5. Rinse well and shape bristles as excessive water is removed.

6. If bristles need shaping, wrap carefully with paper before drying and allow to dry thoroughly.

Spray equipment is used for approximately 85 to 95 percent of all application of various coating materials. Finishing can be done mush faster this way and thus save a lot of the labor cost for applying finishes by brush. Two common types of spraying equipment are the airless sprayers and the air pressure sprayers.

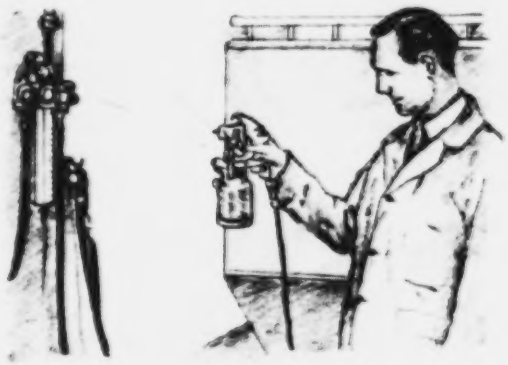
The airless sprayer uses a self-contained pump which develops very high pressure. The coating materials flows from the pump through a small high-pressure hose to a

simple gun. The trigger releases the completely atomized coating material which flows at a higher rate of speed and quantity than an air pressure sprayer. Quality of finish and film thickness are hard to control and it is uneconomical unless a large quantity of coating is used.

The air pressure spraying equipment includes a compressor, air pressure regulator, hose and fluid container. The fluid container is either a pressure-feed tank or a siphon cup. The siphon cup found on a spray gun is a container or cup of about 1 quart capacity. This is used for smaller jobs.

The pressure-feed tank uses a larger container, usually five gallons, which is pressurized by the air system for force fluid through hoses to the spray gun. This system is faster since there is less refill time and more than one gun can be used per tank.

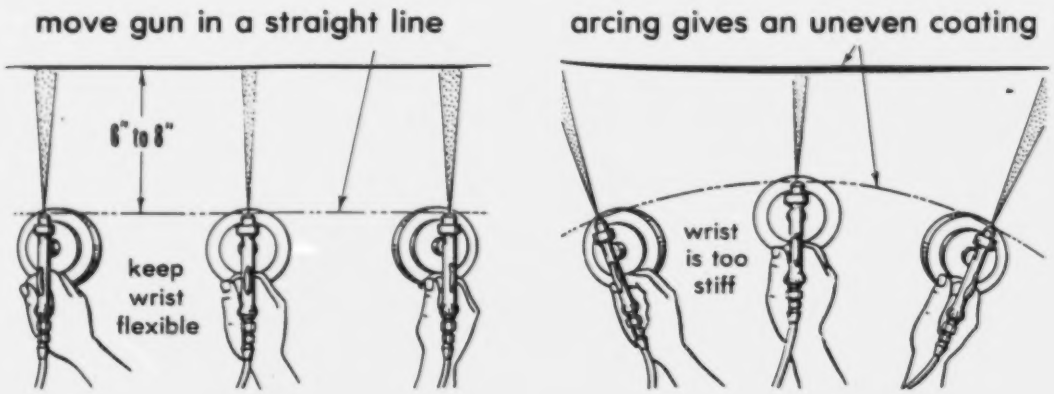
PRESSURE-FEED TANK



SIPHON CUP

The following are helpful suggestions for spraying:

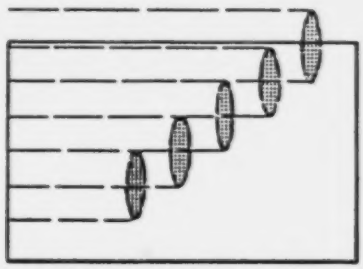
1. Always keep the spray gun 6" to 8" from the surface and move perpendicular to the surface.



CORRECT

INCORRECT

2. Overlap each stroke 50% as spray gun is moved back and forth across the surface. This provides a uniform finish.



OVERLAP STROKES ONE-HALF

3. Release the trigger after each stroke so that the spray will stop while the gun is moving to position for the return stroke.

4. Spraying should be done only with proper ventilation. Face mask or respirator should be worn at all times.

Cleaning and care of spraying equipment prolongs the life and reduces repair and down time. Follow the manufacturer's instructions for ceiling and care of spraying equipment. The following are general suggestions for cleaning and care of siphon-feed spray guns.

1. Release spray gun from cup and loosen air cap. Hold a cloth over the cap and pull trigger to force fluid back into cup.

2. Empty cup and clean thoroughly.

3. Fill cup about half full of thinner and reassemble.

4. Spray thinner, this will clean out inside of gun.

5. With thinner and brush, clean all traces of finish from exterior of gun.

6. Lubricate moving parts.

FLUID REMOVAL

LUBRICATION POINTS

RELATED SAFETY

Finishing of wood floor requires the student to work with power tools and toxic-vapor producing liquids. Proper safety apparel and equipment should be worn at all times. Skin and eye protection are a must as well as inhalation of toxic fumes. Store solvents and finishes properly. Never smoke or have open flames around thinner, cleaner, or resinous coating materials, as most have vapors that are flammable.

Remember to always READ and FOLLOW the manufacturer's instructions regarding their products and equipment!

INSTRUCTOR'S PLAN
MANIPULATIVE LESSON

VIII-C-2(S)

TASK: Finish Wood Floors

AIM: The student(s) will be able to properly prepare and apply floor coating material to wood floors.

TOOLS AND EQUIPMENT: Safety equipment, floor sander(s), extension cord(s), shop vacuum, paint brush(s), spray equipment, hammer, broom

MATERIALS: As per builder's plan - coated abrasives, filler, stain, sealer, resinous coating material, steel wool

REFERENCES: Soderberg, George A., Finishing Technology, Chapters 1, 2, 6, 10, 12, 14, 15
Wagner, Willis H., Modern Woodworking, Units 9, 10

CHECKING STANDARDS:
1. Selection of materials per builder's plans
2. Material estimations of filler, stain, sealer, resinous coating
3. Safe working habits and environment
4. Condition of power equipment

I. PREPARATION (OF THE LEARNER - MOTIVATION)

The life and beauty of a wood floor depends on the finishing operation. Emphasis must be placed upon the importance of preparing the surface to receive the finish. The condition of the surface governs to a large degree the longevity of the finish.

Once the surface is properly prepared, most workers realize that the final product can be no better than the finish. Great care must be exercised in the selection and application of fillers, stains, sealers, and resinous coatings. The manufacturer's instructions and recommendations should be followed at all times.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Select Materials	1. As per builder's plan 2. Manufacturer's recommendations 3. Grit of sanding materials
2. Preparation of Materials	1. Mix fillers according to instructions 2. Mix stains thoroughly 3. Cut sealers according to instructions
3. Finishing Floors	
A. Preparation	1. Sand wood flooring with a 3/0 (very fine) coated abrasive (sandpaper) NOTE: Care should be taken when using power sanding equipment 2. Sweep surface clean of excess sanding dust 3. Vacuum with shop vacuum

B. Natural Finish with Penetrating Sealer

1. Fill open-grain wood such as oak with a natural paste filler and allow to dry
2. Apply a liberal coat of floor sealer with brush, cloth pad or spraying equipment. Allow to dry overnight
3. Apply second coat of sealer
   a. Not in excess of the amount that will penetrate the wood surface
   b. Allow to dry 48 hours or as directed by manufacturer
4. Buff with 3/0 steel wool to achieve desired finish

NOTE: It may be necessary to remove nibs with 360 abrasive paper

5. If preferred, but this is not necessary, wax the sealed surface

NOTE: This may be done by hand or the use of commercial buffer

C. Natural Finish with Resinous Coating

1. Fill open-grain wood such as oak with a natural paste filler and allow to dry
2. Stain, if desired, to enhance wood grain and allow to dry
3. Seal if desired, but it is usually best to apply polyurethane directly to clean dry wood
4. Apply resinous coating, such as polyurethane, with brush or spray equipment per manufacturer's instructions and recommendations. Allow to dry overnight or per instructions

NOTE: First coats can be thinned with special thinner or mineral spirits

5. Sand lightly and apply additional coat(s) per manufacturer's instructions. Allow to dry

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates correct and safe surface (sanding) preparation of wood flooring.
Instructor: Demonstrates proper application of fillers, stains, sealers and/or resinous coatings.
Instructor: Passout job and task sheets.
Student: Practice job and tasks under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Student(s) finishes wood floor(s) per builder's plans, specifications, and manufacturer's instructions and recommendations.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

To obtain the full beauty and service from a wooden floor, there is no short-changing in the finishing operations. The proper surface preparation and application of fillers, stains, sealers and/or resinous coatings are very important. The manufacturer's recommendations and instructions should be followed with a minimum of variations. Remember, there is no substitute for quality of work. Think safety when working with power tools and toxic-vapor producing materials.

SUGGESTED READING FOR STUDENTS:

Finishing Technology, Chapters, 1, 2, 6, 10, 12, 14, 15

THE NEXT LESSON IS: VIII-C-3(S) "Install Resilient Tile Flooring"

JOB SHEET
ON
WOOD FLOORING

VIII-C-2(J)

NAME OF JOB: Finish Wood Flooring

DRAWINGS: Builder's plans and specifications

MATERIALS: As per specifications - coated abrasives, fillers, stains, sealers, resinous coatings, steel wool

TOOLS AND EQUIPMENT: Safety equipment, floor sander(s), extension cord(s), shop vacuum, paint brush(s), spray equipment, hammer, broom

GENERAL INSTRUCTIONS: Study the plans and specifications. Determine the quantities and types of floor finishing materials best suited or recommended for the job. Mix or cut fillers, stains, sealers, and/or resinous coatings according to instructions.

Prepare surface prior to finish applications. Thoroughly clean dust from the surface of floor. Surface should be smooth and level. Care should be taken in working with power sanders.

Apply fillers, stains, sealers, and/or resinous coating as per instructions and recommendations of manufacturer. The final product can be no better than the finish.

Observe all safety rules and regulations. Wear proper eye and ear protection and safety apparel for the particular jobs. Use the correct equipment for the job and maintain safe operating condition of the equipment. Be careful with power cords and extension cords. Maintain proper ventilation when sanding or applying toxic-vapor materials.

PROCEDURES AND/OR TASKS: VIII-C-2(TS), Preparation and Finishing Wood Floors

TASK: Preparation and Finishing Wood Floors

JOB: Finish Wood Floors

TRADE: Building Trades

TOOLS AND MATERIALS: Safety equipment, floor sander(s), extension cord(s), shop vacuum, broom, paint brush(s), spray equipment, coated abrasives, steel wool, fillers, stains, sealers, resinous coatings

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Select Materials	1. As per builder's plans 2. Manufacturer's recommendations 3. Grit of sanding materials
2. Preparation of Materials	1. Mix fillers according to instructions 2. Mix stains thoroughly 3. Cut sealers according to instructions
3. Finishing Floors	
A. Preparation	1. Sand wood flooring with a 3/0 (very fine) coated abrasive (sandpaper) NOTE: Care should be taken when using power sanding equipment 2. Sweep surface clean of excess sanding dust 3. Vacuum with shop vacuum
B. Natural Finish with Penetrating Sealer	1. Fill open-grain wood such as oak with a natural paste filler and allow to dry 2. Apply a liberal coat of floor sealer with brush, cloth pad or spraying equipment. Allow to dry overnight 3. Apply second coat of sealer a. Not in excess of the amount that will penetrate the wood surface b. Allow to dry 48 hours or as directed by manufacturer 4. Buff with 3/0 steel wool to achieve desired finish NOTE: It may be necessary to remove nibs with 360 abrasive paper 5. If preferred, but this is not necessary, wax the sealed surface NOTE: This may be done by hand or the use of a commercial buffer
C. Natural Finish with Resinous Coating	1. Fill open-grain wood such as oak with a natural paste filler and allow to dry

STEPS	KEY POINTS
	2. Stain, if desired, to enhance wood grain and allow to dry 3. Seal if desired, but it is usually best to apply polyurethane directly to clean dry wood 4. Apply resinous coatings, such as polyurethane, with brush or spray equipment per manufacturer's instructions and recommendations. Allow to dry overnight or per instructions NOTE: First coats can be thinned with special thinner or mineral spirits 5. Sand lightly and apply additional coat(s) per manufacturer's instructions. Allow to dry

INSTRUCTOR'S PLAN VIII-C-3(I)
INFORMATIONAL LESSON

SUBJECT: Resilient Tile Flooring

AIM: The student will be able to install resilient tile flooring in a skilled manner, following manufacturer's instructions, and the builder's blueprints.

TEACHING AIDS: Information Sheet VIII-C-3(IS), chalkboard/chalk

MATERIALS: Various samples of types and sizes of resilient floor tile commonly used in building trades.

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 15
Watson, Don A., Construction Materials & Processes, Unit 10

PREREQUISITE EXPERIENCE OF THE LEARNER: The student must meet the requirements set forth by the local school district and the Texas Education Agency for all vocational students. The student must further display a sincere interest in learning the building trades and skills as a career choice.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Resilient flooring materials are available in a tremendous range varying in types, thicknesses, and application requirements. There is also a wide range of adhesives used to fit the different characteristics and requirements of the tile. Because of the complexity of all these factors, it is very important that the application of resilient tile be according to the recommendations and instructions furnished by the manufacturer of the product.

In the application of resilient tile, the smoothness of the surface that it is applied to is extremely important. Rough surfaces or the slightest irregularities on the subflooring will be "telegraphed". They will appear as small peaks or bumps on the surface of the tile. This is especially true for tile made of vinyl, rubber, or linoleum.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTORS TO DO OR SAY
A. Resilient Flooring	1. Definition - materials having varying abilities to give under impact loads and recover their original shape after the load is removed 2. Dense, nonabsorbent 3. Available in tile or large sheets
B. Factors in the Selection of Resilient Floor Tiles	1. Location of floor; whether it is above grade, on grade, or below grade 2. Type of service expected a. Mild b. Moderate c. Severe

3. Expected life
4. Initial cost
5. Ease of maintenance
6. General appearance
7. Safety and acoustical properties
8. Resistance to moisture
9. Thermal conductivity
10. Light reflection

C. Types of Resilient Floor Tile

1. Linoleum
2. Asphalt
3. Vinyl
4. Asbestos-vinyl
5. Rubber
6. Cork

D. Sizes and Composition

1. Linoleum - linseed oil, resin binders, pigments and fillers, bonded to backing of asphalt-saturated rag felt
   a. Sheets - 72" wide and 42' to 90' long
   b. Tiles - 9" x 9" or 12" x 12"; thicknesses of 1/16", 0.090", 1/8"
2. Asphalt - asbestos fibers, fillers and pigments bonded with asphaltic or resinous binders
   a. Standard - 1/8" thick 9" x 9" squares
   b. Special orders - 3/16" thick 12" x 12" squares
3. Vinyl - mineral fillers, stabilizers, and pigments in a polyvinyl chloride (PVC) resin binder
   a. Tiles - 9" and 12" squares; thicknesses of 1/16", 0.080", 3/32", and 1/8"
   b. Special wood grain tile, 4" x 36"
   c. Sheet - 72" wide and 42' to 90' long
4. Asbestos-vinyl - asbestos fibers, vinyls, plasticizers, color pigments and fillers
   a. Tiles - 9" x 9" squares; standard thicknesses 1/16", 3/32", 1/8"
   b. Some patterns available in 12" x 12" squares
5. Rubber - mineral fillers and pigments added to natural, reclaimed, or synthetic rubber
   a. Standard sizes - 9" x 12" squares; thicknesses 1/16", 0.080", 1/8"
   b. Some patterns available in 18" x 36" and 36" x 36"
6. Cork - cork granules combined with suitable thermosetting binder
   a. Standard sizes - 6" and 12" squares; thicknesses range from 1/8" to 1/2"
   b. Produced with square or beveled edges

E. Advantages and Disadvantages of Various Types of Tiles

1. Linoleum
   a. Advantages
      1) Good resistance to wear
      2) Designs and colors extend completely through, maintain appearance through life of tile
   b. Disadvantages
      1) Easily damaged by alkali cleaning solutions
      2) Can't be installed on floors in contact with the earth
2. Asphalt
   a. Advantages
      1) Least expensive of resilient flooring materials
      2) Can be installed on concrete slabs below grade or in contact with water
   b. Disadvantages
      1) Stained and softened by mineral oils and animal fats
      2) Brittleness
      3) Poor recovery from indentation
3. Vinyl
   a. Advantages
      1) Colorless resin permits a wider range of colors
      2) Excellent resistance to wear and abrasion
      3) Can be installed on any type of surface
      4) Excellent resistance to grease, alkali, and stains
   b. Disadvantage - subject to indentation, install above grade
4. Vinyl-asbestos
   a. Advantages
      1) High resistance to abrasion and with lasting appearance
      2) Requires little maintenance
      3) Can be installed above grade, on grade, or below grade
      4) Excellent resistance to grease, oil, alkalis, and mild acids
      5) Generally quieter under foot than asphalt tile
   b. Disadvantage - semiflexible and must be installed over a rigid subfloor
5. Cork
   a. Advantage - under foot comfort and quietness
   b. Disadvantages
      1) Poor resistance to wear and impact loads
      2) Extremely difficult to maintain

3) Very susceptible to grease, alkalis, and stains
4) Should be used only above grade

6. Rubber
   a. Advantages
      1) Resilient under foot
      2) Good resistance to indentation
   b. Disadvantages
      1) Most are softened by petroleum derivatives
      2) Require more maintenance than other resilient flooring
      3) Not recommended on concrete slabs unless special sealers and adhesives are used

F. Layout Procedures

1. Locating the room center by:
   a. Locate the centers of opposite walls
   b. Draw (chalkline) center lines in either direction from walls
   c. Lines should cross at the center of floor
2. Make a trial layout along center lines
3. Adjust tile to eliminate narrow border tile (not less than 1/2 tile width)

G. Installation Procedures

1. Subfloor preparation
   a. Sweep and vacuum
   b. Set nail head properly
   c. Smooth and level joints
   d. Rough edges or surfaces should be eliminated with sandpaper or block plane
2. Spreading adhesive
   a. Spread small amount, about two yards at a time
   b. Notched trowel or spreading tool recommended by manufacturer of adhesive
   c. Correct depth
   d. Allow initial set time before tile is laid, per manufacturer
3. Placement of tile
   a. Begin at the center of the room
   b. Use chalkline as guide for alignment
   c. Butt each tile squarely to the next tile
   d. Lay tile, don't slide
   e. Take time, don't hurry
   f. Roll vinyl, rubber and linoleum tile
4. Cutting and fitting border tiles
   a. Border tiles should not be less than 1/2 tile width
   b. Measure and cut to fit snugly to the wall

5. Installing cove base
   a. Measure and cut to length
   b. Make trial fit before applying adhesive

H. Cost Estimation

1. Figured on area (square feet)
2. Formula for figuring area:
   Length(ft.) x Width(ft.) = Area (sq. ft.)
   Example:
   15' x 15' = 225 sq. ft.
3. Size of packages (sq. ft. coverage)
4. Figure number of boxes by dividing total sq. ft. by the number of sq. ft. per box
   Example:
   225 sq. ft./45 sq. ft/box = 5 boxes
5. Cost = number of boxes x cost/package
   Example:
   5 boxes x $26.55 per box = $132.75

I. Related Safety

1. Apparel
   a. Proper eye protection
   b. Body protection
2. Tools and equipment, proper use of:
   a. Razor blade knife
   b. Household shears
   c. Tin snips
3. Proper ventilation of fumes or vapors of mastics

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have student(s) identify the six different types of resilient tile flooring material.
2. Have student(s) discuss the reasons for selecting various types of resilient tiles.
3. Take field trip with student(s) to local home improvement center and determine the availability and cost of resilient floor tile.
4. Discuss with the student(s) the preparation and installation of resilient tile.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

Simple Recall

1. _____ flooring materials have the abilities to give under impact loads and recover their original shape after the load is removed. resilient

2. To eliminate _____ of rough or irregularities of the subfloor, care should be taken to clean and prepare the surface. telegraphing

3. Common sizes of most resilient tiles are _____ and _____ squares.	9", 12"
4. One of the least expensive resilient tile materials is _____.	asphalt
5. _____ floor tiles should not be installed on floors in contact with the earth.	linoleum
6. _____ floor tiles can be installed on any surface.	vinyl
7. Vinyl and _____ floor tiles offer excellent resistance to grease and alkalis.	vinyl-asbestos
8. When underfoot comfort and quietness is most important, use _____ resilient tiles.	cork
9. When installing resilient tile flooring, tile installation generally begins in the _____ of the room.	center
10. Border tiles should not be less than _____ of a tiles width.	1/2

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

Resilient tile material are available in various types, thicknesses, and application requirements. Six basic types are linoleum, asphalt, vinyl, vinyl-asbestos, rubber, and cork.

Location of floor (grade), cost, expected life, ease of maintenance, resistance to moisture, thermal conductivity, safety and acoustical properties, light reflection and type of service expected are all factors to consider when selecting the best type of resilient tile for a particular job.

Tiles are generally available in 9" and 12" squares and thicknesses of 1/16", 0.080", 0.090", 3/32", 1/8", 1/4" and 1/2". Installation and selection of tiles should be per manufacturer's instructions.

Advantages of linoleum tiles are good resistance to wear and the designs and colors extend completely through to the backing that maintains their appearance through the life of the tile. Disadvantages would be that linoleum tiles are easily damaged by alkali cleaning solutions and shouldn't be installed on floors in contact with the earth.

Major advantages of asphalt tiles are: lease expensive type of resilient flooring and the tile can be installed on concrete slabs below grade or in contact with earth. Disadvantages are: brittleness; stained and softened by mineral oils and animal fats; poor recovery from indentation.

Advantages of vinyl tiles are: colorless resin permits a wider range of colors; excellent resistance to wear and abrasion; can be installed on any type of surface;

and excellent resistance to grease, alkali, and stains. The major disadvantage is that vinyl tiles are subject to indentation.

Vinyl-asbestos tiles have a high resistance to abrasion and with lasting appearance, requires little maintenance, can be installed at any grade, have excellent resistance to grease, oil, alkalis and mild acids, and are generally quieter underfoot than asphalt. Vinyl-asbestos tiles are semiflexible and must be installed over a rigid subfloor.

Cork resilient tile provides under foot comfort and quietness. However, cork has poor resistance to wear and impact loads, it is extremely difficult to maintain, it is very susceptible to grease, alkalis and stains and should be used only above grade.

Rubber tiles are resilient under foot and have good resistance to indentation. Most rubber tile is softened by petroleum derivatives and require more maintenance than other resilient flooring. Rubber tiles are not recommended to be used on concrete slabs unless special sealers and adhesives are used.

Layout and application of adhesive are important in the success of a good resilient floor. Divide room into quarters by two center lines. Adjust for border tiles. Spread adhesive according to instructions. Begin in center of room and work out to walls.

Resilient tile material is sold in boxes that contain a certain number of square feet. 12" x 12" squares are commonly sold in 45 sq. ft. boxes. Total amount of material needed is determined by figuring square feet of a room. To determine square feet of a room, use the following formula:

Width in feet x Length in feet = Area in square feet

When installing resilient tile, wear proper safety apparel and use all tools correctly. Remember to follow manufacturer's instructions closely.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 15

THE NEXT LESSON IS: VIII-D-1(I) "Install Kitchen/Bathroom Cabinets"

INFORMATION SHEET
ON
FINISH FLOORING

VIII-C-3(IS)

SUBJECT: Resilient Tile Flooring

INTRODUCTORY INFORMATION:

Probably the first floor covering was packed earth or clay, used to level the natural rock floors of caves. Egyptians used squared sandstone blocks for finish flooring in their tombs and temples. The Greeks used precisely cut and marble slabs for finish flooring in their temples. The Romans developed the first decorative flooring by cementing small marble chips to produce the mosaic floors that have lasted centuries.

Many types of floor coverings are used as wearing surfaces over concrete slabs and wood subfloors in modern construction practices. Resilient flooring material such as linoleum, rubber, cork, vinyl, asphalt, and asbestos-vinyl have replaced much of the wood floorings.

Careful consideration should be given in selection of a floor covering. Factors that should be considered are: moisture, type of wear, cost, installation, maintenance, and expected service life. After these practical factors have been weighed, visual and esthetic considerations such as color, texture, resilience, and sound-absorbing qualities must also be considered.

GENERAL INFORMATION:

RESILIENT FLOORING

Resilient flooring materials have the ability to give under impact loads and recover their original shape after the load is removed. They are available in various types, sizes, thicknesses, and application requirements. Special attention should be given to the smoothness of the surface that resilient flooring are applied to. Any irregularities or rough surfaces will be "telegraphed" on the surface of the material.

Adhesives (mastics) used for resilient flooring installation are available to fit many different requirements. Follow the manufacturer's instructions and recommendations based on different types of flooring materials, subfloors (types and conditions), forms applied (tile or sheet) and conditions (environment) under which the installation is made.

FACTORS IN THE SELECTION OF RESILIENT TILES

Many factors must be considered when selecting the various types or resilient flooring materials. Cost, required resilience for safety and acoustical properties, resistance to moisture, ease of maintenance, thermal conductivity, light reflection and appearance are but a few. An extremely important factor is the location of the floor, whether it is above grade, on grade, or below grade. The life of a flooring material is not only the physical life of the material, but is also in terms of time that an acceptable appearance lasts.

TYPES OF RESILIENT FLOORING TILES

Resilient floor tiles are produced of one of six following materials:

1. **Linoleum** was the only type of resilient flooring material available for many years. Developed in England over 100 years ago, it consists of linseed oil, resin binders, pigments and fillers bonded to a backing of asphalt-saturated rag felt. The thin sheets of linoleum are seasoned in ovens for 2 to 4 weeks and then given several coats of lacquer for greater stain and spot resistance.

   Linoleum tiles are available in 9" or 12" squares and three thicknesses of 1/16" (light gauge), 0.090" (standard), and 1/8" (heavy gauge). Light and standard gauge linoleum tiles generally have asphalt impregnated backings and are used for residences and light commercial construction. The heavy gauge tiles are manufactured with burlap backing and are used for heavy commercial applications.

   Linoleum has good resistant to wear. The appearance of designs and colors are maintained during the life of the flooring because they usually extend completely through to the backing of inlaid linoleum. Alkali cleaning solutions easily damage linoleum flooring. Linoleum flooring can not be installed on floors in contact with the earth.

2. **Asphalt** tiles are produced in a marblezied pattern that runs completely through the tile. It consists of asbestos fibers, fillers, and pigments bonded with asphaltic or resinous binders. Standard tiles are 1/8" thick 9" squares. On special large-quantity orders 3/16" thick 12" square tiles are available.

   Most asphalt tiles are stained and softened by mineral oils and animal fats. Grease-resistant tiles are available from some manufacturers at a much higher cost. Individual tiles are brittle and have poor recovery from indentation. However, asphalt tile is one of the cheapest of the resilient floorings. It can be installed on concrete slabs below grade or in contact with water.

3. **Vinyl** tile is basically a vinyl sheet backed with asphalt-saturated felt and then cut into tile-size units. Vinyl flooring consists of mineral fillers, stabilizers, and pigments in a polyvinyl chloride (PVC) resin binder. Vinyl tiles are produced to simulate the color and texture of brick, quarry tile, wood parquet, and marble. Vinyl tiles are produced in 9" and 12" squares in standard thicknesses of 1/16", 0.080", 3/32", and 1/8".

   Vinyl products can be installed on any type of surface and the colorless resin permits a wide range of colors. Vinyl tiles have excellent resistance to wear, abrasion, grease, alkali, and stains. However, they are subject to indentation and should be installed above grade.

4. **Vinyl-asbestos** consists of blended compositions of asbestos fibers, vinyls, plasticizers, color pigments, and fillers formed into thin sheets under heat and pressure. Tiles are available in 9" squares in standard thickness of 1/16", 3/32" and 1/8". Some are available in 12" x 12" squares.

   Vinyl-asbestos tiles are produced to represent stone, travertine marble, wood, and exposed-aggregate concrete. Many marbleized patterns run completely through the tile.

Vinyl-asbestos tile must be installed over a rigid subfloor because it is semiflexible. It has a high resistance to abrasion and with a lasting appearance that can be maintained for extended periods without waxing. Vinyl-asbestos tile also has excellent resistance to grease, oil, alkalis, and mild acids. It is generally quieter under foot than asphalt tile.

5. Rubber tile is produced from natural, reclaimed, or synthetic rubber. Mineral fillers and pigments are added to produce a limited range of colors and marbleized patterns. Standard sizes are 9" and 12" tiles in thicknesses of 1/16", 0.080" and 1/8".

   Rubber tile require more maintenance than most other resilient flooring. Rubber tiles should not be used on concrete slabs in contact with the earth unless special sealers and adhesives are used. Most rubber tiles are softened by petroleum derivatives and resistance to grease and vegetable oil varies with the manufacturer. Rubber tile floors are resilient under foot and have good resistance to indentation.

6. Cork tile consists of cork granules combined with a suitable thermosetting binder. The top surface of the tile may be given a plastic coating to improve the wearing surface and develop a gloss. Standard tile sizes are 6" and 12" squares in thicknesses ranging from 1/8" to 1/2".

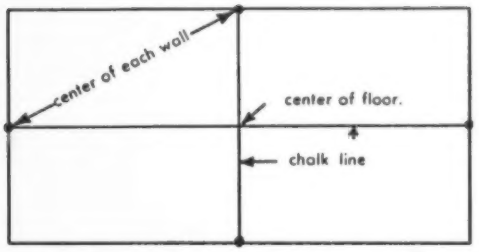
   Cork tiles are highly desirable where under foot comfort and quietness are of great importance. However, their maintenance is extremely difficult because of their poor resistance to wear and impact load. It is very susceptible to grease, alkalis, and stains and must be kept coated with a heavy coating of wax. Cork tile floors should be used only above grade.

LAYOUT AND INSTALLATION PROCEDURES

The smoothness of the surface is extremely important regardless of the type of subfloor the tile is to be installed over. The slightest irregularities, rough surface, and/or nail heads can be telegraphed through the tile to the surface in forms of blisters or bumps. Linoleum is especially susceptible to these irregularities and is often applied over a base of felt paper.

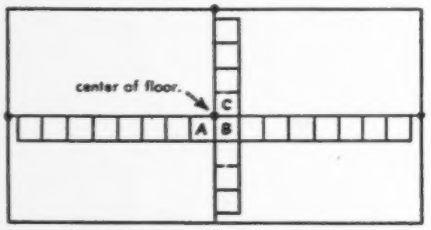
Before applying the tile, clean the surface thoroughly by sweeping and vacuuming carefully. Remove and eliminate rough edges produced by joints. Sandpaper or a block plane can be used for wood subflooring. Chisels or rubbing blocks can be used on concrete slabs. Remember, time spent here is very important later in the appearance and maintenance of the tile covering. Extreme care should be taken in cleaning and smoothing the surface.

Begin the layout procedure by locating the center of all (four) opposites walls and snap a chalkline across the width of the room. Next, snap a chalkline across the length of the room. The lines should cross at the center of the room.

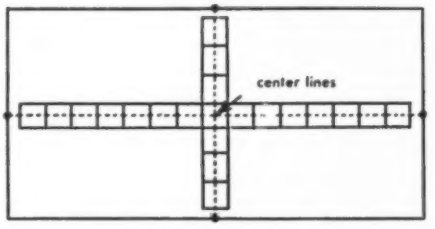


LOCATING THE CENTER OF THE FLOOR.

Lay a row of uncemented tiles along either line with the edges of the tile on the line. Lay another row along the other line. Measure the distance between the wall and tile of each line. Shift and adjust the two rows of tile until the border tiles are the same. Snap new chalklines if necessary. Border tiles should not be less than half a tile wide.



LAYOUT FOR EVEN NUMBER OF TILES.



LAYOUT FOR ODD NUMBER OF TILES.

Before the application of adhesive, be sure the surface is perfectly clean. Also, make sure that the adhesive is correct for the tile chosen. Beginning at the center, spread a thin coat of adhesive over about two yards or not over one-quarter of the total area. The coat should be spread at the correct thickness and along the chalkline. Follow the manufacturer's instructions on the thickness of the coat and the recommended spreading tool.

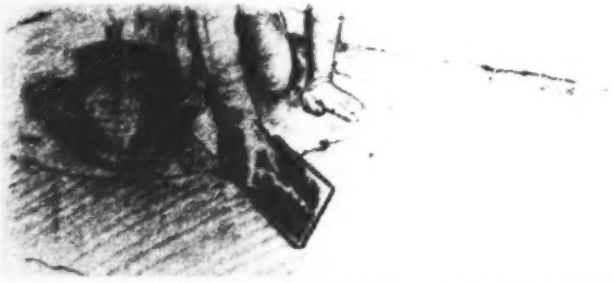
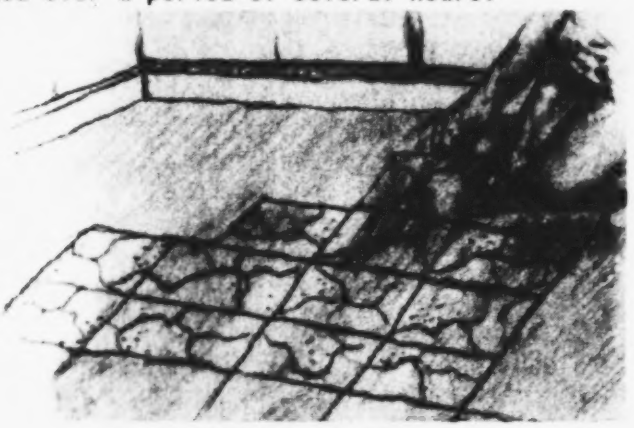


Fig. 15-25. SPREADING ADHESIVE WITH TROWEL.

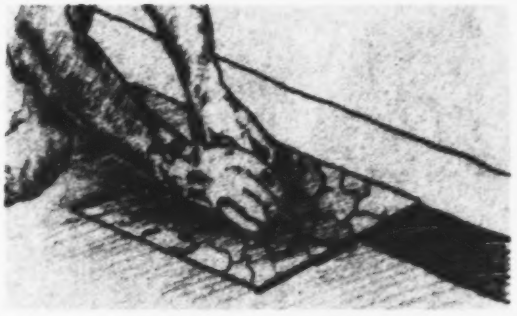
Before any tile is laid, allow the adhesive to set. This time may vary from 15 minutes or longer, depending on the type of adhesive and manufacturer's recommendations. After the adhesive is set, start laying the tile at the center of the room. Use the chalkline to align the tile.

Butt each tile carefully and squarely to one another. Remember to lay the tile, not slide it. Sliding can cause the adhesive to ooze up between the joints and prohibit a good fit between tiles. Take time and position tile correctly. Most adhesives can be worked over a period of several hours.

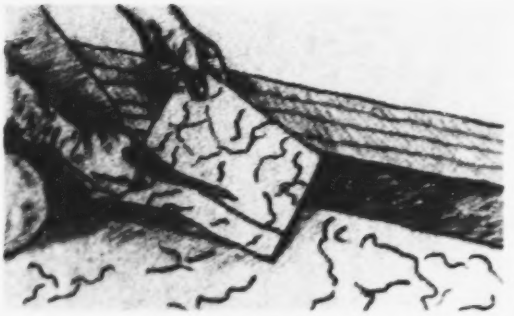


LAYING THE TILE

After the main area of tile is laid, set the border tiles. Place a full tile directly over the last full tile in the row and align. Lay a second tile over the loose tile and push it up against the wall. With a pencil, mark the bottom tile. Cut the bottom tile with household shears, tin snips, or special cutter recommended by manufacturer. Place border tile in place. Roll the tile if necessary.



MARKING BORDER TILE



CUTTING TILE

After the entire floor is completed, cove base can be installed along the wall to conceal the edges of tile. Cut cove base to necessary length and make a trial fit of each piece and adjust length where necessary. Apply the correct adhesive and press in place.

COST ESTIMATION

The amount and cost of materials can be determined by figuring the total square feet of the area to be covered. The formula for figuring area is:

Area(square feet) = Width in feet x Length in feet

Example:

A kitchen 15' x 15' will require 225 sq. ft. of 12" square tile or 5 boxes to cover the entire floor.

Area(sq. ft.) = Width' x Length' or 15' x 15' = 225 sq. ft.

No. of boxes = Area(sq. ft.)/Sq. ft. per box or
225/45 sq. ft. per box = 5 boxes

Cost = No. of boxes x cost per box or 5 x $26.55 = $132.75

SAFETY

Proper apparel such as clothing and eye protection should be worn at all times. Wear respirators or filter masks if required by manufacturers of adhesives. READ and FOLLOW the manufacturer's instructions regarding their product!

INSTRUCTOR'S PLAN VIII-C-3(S)
MANIPULATIVE LESSON

TASK:	Install Resilient Tile
AIM:	The student will be able to install resilient tile floor covering.
TOOLS AND EQUIPMENT:	Necessary safety equipment, pocket tape, pencil, straightedge, hammer, notched trowel, household shears or tin snips, chalkline, sandpaper, block plane
MATERIALS:	As per builder's plans - resilient tile, adhesive
REFERENCES:	Wagner, Willis H., Modern Carpentry, Unit 15 Watson, Don A., Construction Materials and Processes, Unit 10
PREREQUISITE EXPERIENCE OF THE LEARNER:	The student(s) must have successfully completed related lesson, VIII-C-3(I)
CHECKING STANDARDS:	Teacher's check on quality/procedures of students work: Example: 1. Selection of material 2. Accurate quantity of materials and supplies 3. Installation methods 4. Quality of work 5. Selection of tools 6. Safe work habits

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Before resilient tile floor covering is installed, the surface must be properly prepared. All rough spots, irregularities, bad joints, and nail heads must be taken care of. The smoothness of the surface is extremely important to prevent "blisters" in the floor surface.

Due to the many types of resilient tile floor covering and adhesives, each application requires special attention. The manufacturer's recommendations and instructions should be closely followed in these various applications. Take sufficient time in the application of adhesives and placement of tile to insure a quality and trouble-free job.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Material Selection	1. As per building plans, estimations 2. Patterns and colors 3. Suited for job 4. Availability
2. Preparation of Subfloor	1. Check subfloor to insure smoothness of surface a. Set nail heads b. Smooth and level joints

c. Rough edges or surfaces should be eliminated with sandpaper or block plane
2. Sweep and vacuum subfloor completely clean
3. Layout guide lines
   a. Locate center of room and snap chalkline through center parallel to long walls
   b. Lay out and snap second line through center 90° with first line
4. Check guidelines
   a. Lay out tiles along guidelines from center of room in one quadrant
   b. If distance between last tile and wall is less than 2", more than 8", adjust guidelines one-half of tile dimension so that border tiles will be same size

NOTE: Border tiles should not be less than one-half tile width

3. Installation of Tile

1. Spread adhesive in one quadrant of subfloor
   a. Spread even with chalkline but do not cover
   b. Use proper tool or applicator to spread adhesive
   c. Follow manufacturer's instructions
2. Lay tile
   a. Start in center of room
   b. Make sure edges of tile align with chalkline
   c. Butt each tile squarely to adjoining tile
   d. Carefully place each tile, do not slide
   e. Cut and fit border tiles
3. Repeat the above steps for the remaining quadrants
4. Install cove base
   a. Measure, cut to length, and make trial fit
   b. Apply adhesive to cove base, carefully press into place

NOTE: Carefully remove any spots of adhesive following manufacturer's instructions

4. Safety

1. Observe all safety rules and regulations
2. Use correct tool for the job
3. Wear proper safety apparel
4. Follow manufacturer's recommendations
5. Think safety at all times

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates proper preparation of subfloor.
Instructor: Demonstrates proper procedure of applying adhesive.

Instructor: Demonstrates proper procedure of installing resilient tile.
Instructor passes out job and task sheet.
Students practice job and task under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Students install resilient tile per builder's plans.
Students install cove base necessary for trim.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

Take sufficient time to prepare subfloor before installing tile. Any foreign material, nail heads or surface irregularities will show through on the surface as a blister or bump. Follow the manufacturer's recommendations and instructions on the selection of tile for subfloor, selection of adhesive and installation of both tile and adhesive. Work safely and use the tools for the purpose they were intended to be used.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 15

THE NEXT LESSON IS: VIII-D-1(S) "Installing Kitchen/Bathroom Cabinets"

JOB SHEET
ON
RESILIENT TILE FLOORING

VIII-C-3(J)

NAME OF JOB: Install Resilient Flooring

DRAWINGS: Builder's plans, detailed drawings

MATERIALS: As per specification - resilient tile, adhesive

GENERAL INSTRUCTIONS: Study the builder's plans and specifications. Determine the quantity and type of tile and adhesive best for the job.

Be sure that the surface to be tiled is as smooth as possible. Clean thoroughly by sweeping and vacuuming the surface. Snap chalklines (two) to divide the room into quarters. Make a trial layout of tiles and adjust to prevent narrow border tiles. Follow manufacturer's instructions on the use of adhesives and types of tile to install. Take sufficient time needed to lay tile, don't slide.

Care should be taken when using cutting tools for trimming border tiles. Observe all safety rules and regulations.

PROCEDURES AND/OR TASKS: VIII-C-3(TS) Install Resilient Tile

TASK: Install Resilient Tile

JOB: Install Resilient Flooring

TRADE: Building Trades

TOOLS AND MATERIALS: Tile and adhesive per builder's plans and specifications, pocket tape, pencil, straightedge, hammer, notched trowel, household shears or tin snips, chalkline, sandpaper, block plane, safety equipment

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions 3. Sizes of materials (width, length, thickness) as per specifications
2. Preparation of Subfloor	1. Check subfloor to insure smoothness of surface a. Set nails heads b. Smooth and level joints c. Rough edges or surfaces should be eliminated with sandpaper or block plane 2. Sweep and vacuum subfloor completely clean 3. Layout guidelines a. Locate center of room and snap chalkline through center parallel to long walls b. Lay out and snap second line through center 90^0 with first line 4. Check guidelines a. Lay out tiles along guidelines from center of room in one quadrant b. If distance between last tile and wall is less than 2", more than 8", adjust guideline one-half dimension so that border tiles will be same size NOTE: Border tiles should not be less than one-half tile width
3. Installation of Tile	1. Spread adhesive in one quadrant of subfloor a. Spread even with chalkline but do not cover b. Use proper tool or applicator to spread adhesive c. Follow manufacturer's instructions 2. Lay tile a. Start in center of room

STEPS	KEY POINTS
	b. Make sure edges of tile align with chalkline c. Butt each tile squarely to adjoining tile d. Carefully place each tile; do not slide e. Cut and fit border tiles 3. Repeat the above steps for the remaining quadrants 4. Install cove base a. Measure, cut to length, and make trial fit b. Apply adhesive to cove base, carefully press into place NOTE: Carefully remove any spots of adhesive following manufacturer's instructions

INSTRUCTOR'S PLAN VIII-D-1(I)
INFORMATIONAL LESSON

SUBJECT: Kitchen/Bathroom Cabinets

AIM: The student will be able to install pre-built cabinets as per the builder's plans and specifications while performing sound construction practices and procedures.

TEACHING AIDS: Information Sheet VIII-D-1(IS), chalkboard/chalk, transparencies (interior trim), samples of hardware, cabinets, door and drawer construction

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 14

PREREQUISITE EXPERIENCE OF THE LEARNER: The student(s) must have successfully completed previous lessons in Major block VIII. The student(s) must also exhibit a sincere interest in learning the building trades while meeting the requirements of the Texas Education Agency and local school district.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Carpentry is the largest skilled trade in the United States, employing over one million people. In carpentry there are two types of work: rough carpentry (framing and such) and finish carpentry. Finish carpenters generally install kitchen and bathroom cabinets as well as a variety of things. Cabinets must be installed accurately and carefully.

Most kitchen and bathroom cabinets used today are prefabricated. Prefabricated cabinets are often superior to cabinets built on the job site. Prefabricated cabinets come in standard-sized units and may be arranged to fit almost any kitchen layout. Careful planning must be given to unit selection and placement. If this is done, the cabinets present an attractive appearance and satisfy specific needs.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTORS TO DO OR SAY
A. Cabinetwork	1. Usually applies to interior woodwork that is fixed and non-movable after it is installed 2. Finish carpenters usually install cabinets 3. Skills involved a. Operation of hand and power tools b. Reading blueprints and drawings c. Assembling parts together 1) Glue and clamp 2) Insert nails, dowels and screws d. Install hardware
B. Types of Cabinetwork	1. Built-on-the-job by carpenter 2. Custom-built units constructed in local cabinet shops or millwork plants 3. Prefabricated - three types a. Dissembled

b. Assembled but not finished
c. Assembled and finished

C. Cabinet Drawings
(Show Samples)

1. Floor plan - shows location of cabinets
2. Elevations - provide detailed dimensions
3. Drawing serves as a guide to the carpenter

D. Basic Kinds of Cabinets and Sizes

1. Base unit - basic storage section
   a. 24" deep
   b. 36" tall
   d. Toe space, 4" high, varies in depth
2. Wall unit - hung above countertop
   a. 12" deep
   b. 30"-36" tall
   c. 15"-18" above work space
   d. 24" minimum over sink or cooking unit
3. Tall unit - used for oven cabinet and storage
   a. 7'-0" tall
   b. 24" deep
   c. Toe space same as base unit
4. Special-purpose unit - desk unit, sink unit, stove and oven cabinet, etc.
5. Bathroom vanity
   a. 18" to 22" deep
   b. 31" tall
   c. 3" knee space
   d. Toe space

E. Components of a Typical Cabinet

1. Shelves - standard 3/4" thick, maximum space of supports 42"
   a. Common materials
      1) Solid wood
      2) Plywood
      3) Particle board
   b. Methods of support
      1) Bracket carried in notches
      2) Bracket held with wood screw
      3) Wood pin
      4) Metal or plastic pin
2. Drawers
   a. Lip drawer - permits greater freedom in the fit
   b. Flush drawer - must be carefully fitted
   c. Joints
      1) Rabbet
      2) Dados and grooves
      3) Dado-rabbet
      4) Dovetail
      5) Edge
      6) Mortised and tenoned
   d. Drawer guides
      1) Corner
      2) Center
      3) Side

3. Cabinet doors
   a. Swinging - hung three ways
      1) Flush
      2) Overlay
      3) Lip
   b. Sliding
      1) Plain groove - rabbet and groove
      2) Self-lubricating plastic track
4. Countertops
   a. Base or core material - plywood, particle board or hardboard
   b. Surfaced with plastic laminate (formica)
   c. Bond - contact cement
   d. Trim - smooth to touch, wear better
   e. Prefabricated

F. Construction Procedures

1. Built-in-place
   a. Frame construction
   b. Non-frame construction
2. Pre-built, constructed in shop and brought to building site

G. Cabinet Hardware

(Show Samples)

1. Hinges
   a. Surface
   b. Butt
   c. Concealed wrap-around
   d. Semi-concealed
   e. Pivot
   f. Piano
2. Catches
   a. Magnetic
   b. Friction
   c. Roller
   d. Ball or bullet
3. Pulls and knobs - wide variety of sizes, styles, and designs

H. Related Safety

1. Apparel
   a. Proper eye protection
   b. Proper ear protection
   c. Body protection
2. Tools and equipment, proper use of:
   a. Power saws
   b. Jointer
   c. Handsaw
   d. Hammer
   e. Hand and power drills
3. Proper ventilation - sawdust and finishing materials
4. Good housekeeping practices

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have student(s) discuss the nature of cabinetwork and types.
2. Have student(s) discuss construction of built-in, shop units, drawers, shelves, doors, and countertops.
3. Take field trip with student(s) to local cabinet shop and/or construction site for built-in cabinets.
4. Discuss with student(s) the different joints used in construction of cabinets.
5. Discuss with student(s) the proper and safe use of power equipment such as radial-arm saw, table saw, jointer, etc.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

Simple Recall

1. The construction and installation of kitchen and bathroom cabinets is generally done by _____ carpenters. finish
2. Most cabinets installed today are the _____ type. prefabricated
3. The _____ plan of architectural plans show the location of the cabinets. floor
4. The _____ unit that is the basic storage unit of kitchen cabinets is commonly 24" deep and 36" tall. base
5. The _____ unit is hung above the countertop. wall
6. The two general types of drawers are lip and _____. flush
7. Swinging and sliding are the two basic types of _____ used for cabinetmaking. doors
8. Rabbet, dados and grooves, dado-rabbet and dovetail are the _____ commonly used for cabinetmaking. joints
9. Cabinet hardware used on cabinets are either hinges, _____, and pulls and knobs. catches
10. When using _____ equipment such as radial-arm saws, table saws, care should be taken to use them safely. power

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

Cabinetwork usually applies to interior woodwork that is fixed and non-moveable after it is installed. Finish carpenters generally install and build cabinets.

Three types of cabinetwork are: built-on-the-job; custom-built by local cabinet shops or millwork plants; and prefabricated. These types of cabinetwork are constructed and installed according to architectural plans which serve as a guide for the carpenter.

Four basic kinds of cabinets are used in the completed kitchen: base unit, wall unit, tall unit, and special-purpose unit. Standard sizes are established which makes many combinations available to fit most construction needs. Careful planning is important in the utilization of space and appearance of cabinets.

Basic components of cabinets are: shelves, drawers and guides, doors, and tops. Common joints used in the construction of these basic components are: rabbet, dados and grooves, dado-rabbet, dovetail, and edge. Cabinet hardware adds beauty and serviceability when properly selected.

Follow safety rules and regulations when working with power tools. Good housekeeping habits provide a cleaner and more safe working environment.

SUGGESTED READING FOR STUDENT:

Modern Carpentry, Unit 18

THE NEXT LESSON IS: VIII-E-1(I) "Interior Moldings"

INFORMATION SHEET VIII-D-1(IS)
ON
CABINETWORK

SUBJECT: Kitchen/Bathroom Cabinets

INTRODUCTORY
INFORMATION:

Cabinetwork in modern construction generally refers to kitchen and bathroom while including such work as closet shelving, built-in storage, and special units like desks and dressing tables. The job of constructing and installing of cabinets is generally done by a finish carpenter. Their work is classified as finish or trim work and they are responsible for installing the visible items in a building. They cut, fit, and install moldings, baseboards, doorframes, doors, hardwood floors, windows, paneling, kitchen and bathroom cabinets and built-ins. Finish carpenters perform a wide variety of other work requiring the skillful use of many different tools and machines.

Most cabinets used today are prefabricated, that is mass produced in shops and factories. The quality of prefabricated cabinets varies greatly. They are often superior to cabinets built on the job site. They also are a major consideration in labor cost. The use of modern production equipment makes it possible for such cabinets to have such features as all lumber-core plywood construction, complicated joinery such as multiple dovetail joints on front and back of drawers, commercial drawer guides, and the finest finishes.

GENERAL INFORMATION:

TYPES OF CABINETWORK

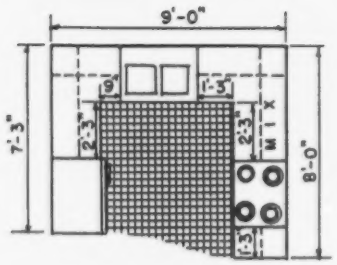
There are three basic production methods for producing cabinets. The first of these is the construction of the cabinets on site. The construction is relatively simple (joints) and each unit is built piece by piece according to floor plans and detail elevations. Assembly is generally with glue and nails. Such construction is on the decline because units of better quality and less expensive are readily available.

The second method is to purchase cabinets disassembled (knocked down) and then assemble the parts and install the cabinets. Cabinets of this type have medium-quality joinery with the possibilities of locked joints on the drawers. Most parts are either nailed or stapled together.

The last method is the most popular in today's construction. These cabinets are prefabricated in shops and factories in mass production. Although the quality varies greatly, they are often more superior to types. The modern production equipment makes it possible for such cabinets to have such features as all lumber-core-plywood construction, complicated joinery such as multiple dovetail joints on front and back of drawers (generally limited to fine furniture), commercial drawer guides, and the finest finishes.

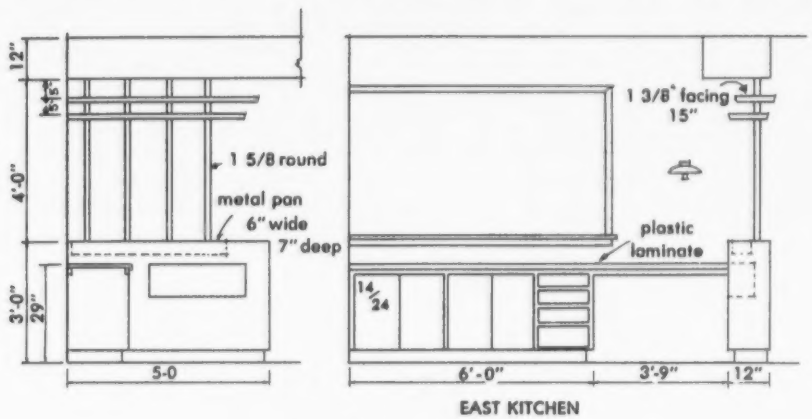
CABINET DRAWINGS

The drawing that a carpenter uses in construction or installation of prefabricated cabinets serves as a guide. The floor plan shows the location of not only cabinets, but appliances also.



FLOOR PLAN

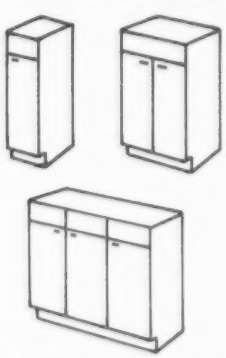
The detail elevation provides detailed dimensions. Drawings of this type are scaled and thus the need of extensive dimensioning is reduced. The carpenter is responsible for detail of joints and structure when the cabinets are built on site.



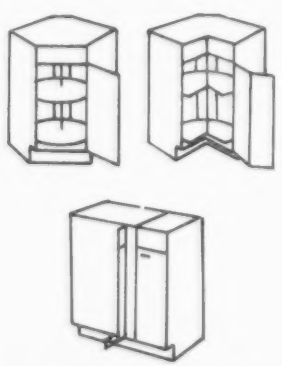
DETAIL DRAWING

BASIC CABINET UNITS AND SIZES

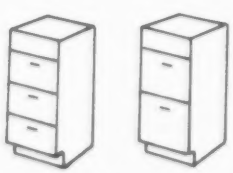
Kitchen cabinets are available in four basic units. They are the base unit, wall unit, tall unit, and special-purpose unit. The base cabinet is the basic storage unit of the kitchen. It is designed with drawers, doors, and shelves for storage and a work surface for food preparation and clean-up after meals. Pots and pans, serving dishes, food staples, electrical appliances, and cleaning supplies are commonly kept in the base unit.



DOOR CABINET

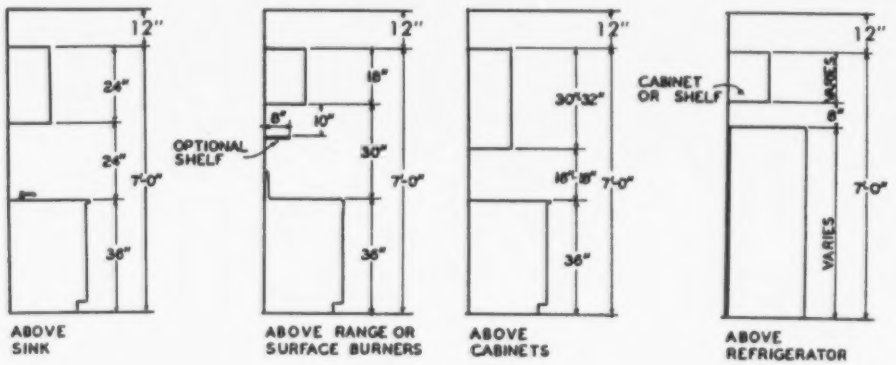


CORNER CABINETS

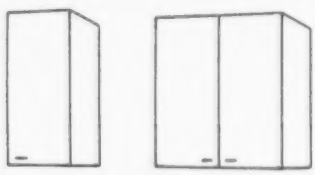


DRAWER CABINET

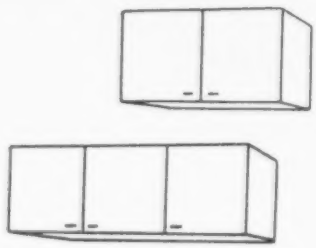
Standard sizes of base cabinets for kitchens are usually 36" high and 24" deep. The countertop generally extends 1" over the cabinet top. The vertical space between the base cabinet and the wall cabinet may vary from 15"-18" above regular work space. The minimum space increases to 24" when the wall cabinet is located over a cooking unit or sink. Toe space is generally 4" high and depth varies.



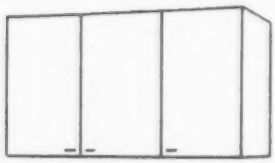
The wall cabinets are fastened to the wall. Typically, there is a 12" space from the top of the wall cabinet to the ceiling. The wall units are generally 12" deep and 30"-36" tall. They are commonly used for storage of dinnerware, glassware, serving dishes, and food staples. Modern wall units have adjustable shelving to accommodate a wide variety of sizes and shapes.

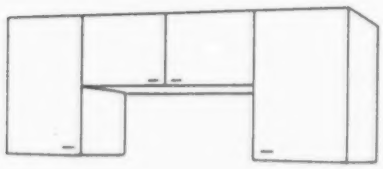


STANDARD

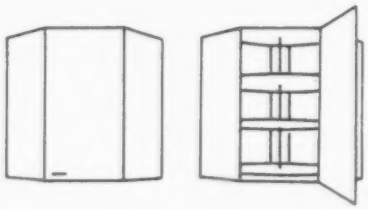


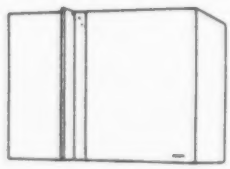
OVER-APPLIANCE





COMBINATION



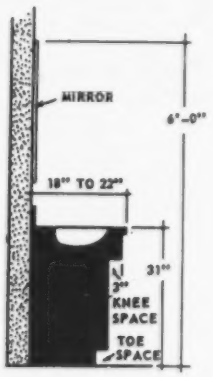


CORNER

Tall units are generally 7'-0" tall and 24" deep. They are used for basic storage and have shelves for can goods, dishes, cleaning supplies, linens, and goods packaged in boxes.

Special-purpose units vary in size depending upon the location in the kitchen and/or the appliance installed in them. They are used as desk units. Sink cabinets, stove and oven units, and pull-outs of various designs.

Bathroom cabinets (vanities) are very similar to the base and wall units used in the kitchen. They vary in depth from 18" to 22" and are normally 31" tall. The counter is extended to provide a knee space. The toe space is 4" high and depth varies.

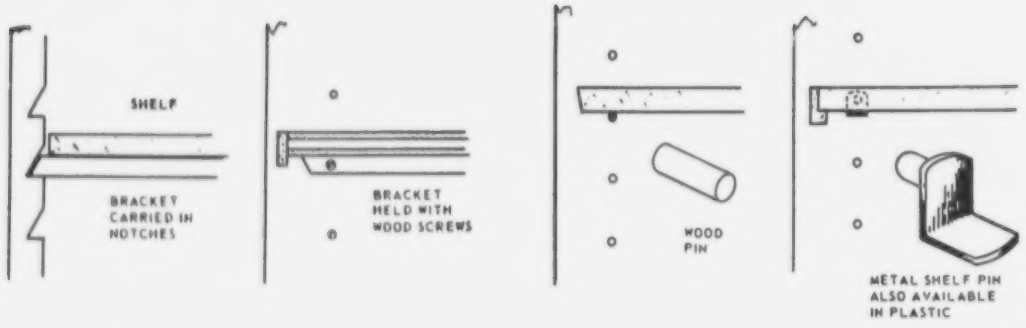


BATHROOM LAVATORY

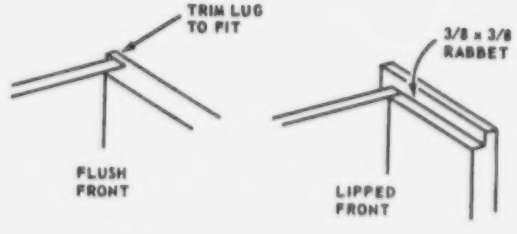
COMPONENTS OF A TYPICAL CABINET

Shelves are used through all cabinetwork. Common materials for shelving are solid wood, plywood, and particle board. The standard thickness is 3/4" and should be supported on supports not spaced more than 42" apart. This is especially true for heavy loads such as can goods, books, and the like.

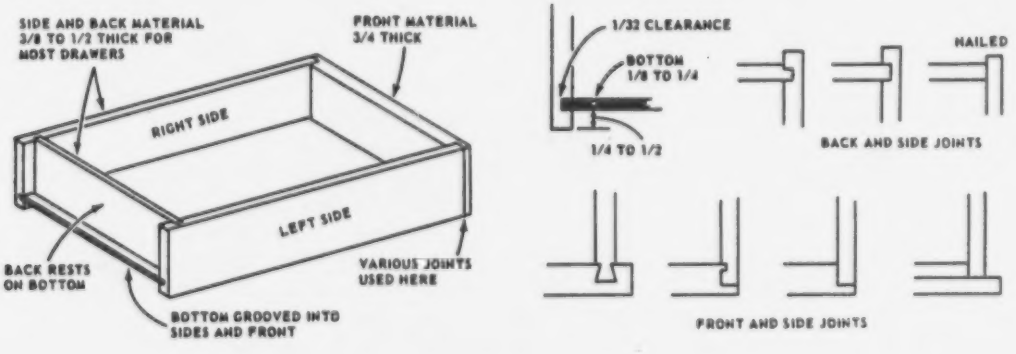
Shelving is either fixed or adjustable. When possible, it is better to have cabinets with adjustable shelving. This allows for greater flexibility for varying shapes. The illustration below shows four popular methods of supporting shelves.



Drawers for kitchen or bathroom cabinets are either lip or flush types. Lip drawers have a rabbet cut around the sides, top, and bottom of drawer front which cover the opening for the drawer. This lip allows a greater freedom of fit. The flush drawer fits inside the opening and flush with the face of the cabinet when closed. The flush drawers are used for furniture and very little for kitchen cabinets because they are difficult to fit. There is very little room for error in this type of drawer.

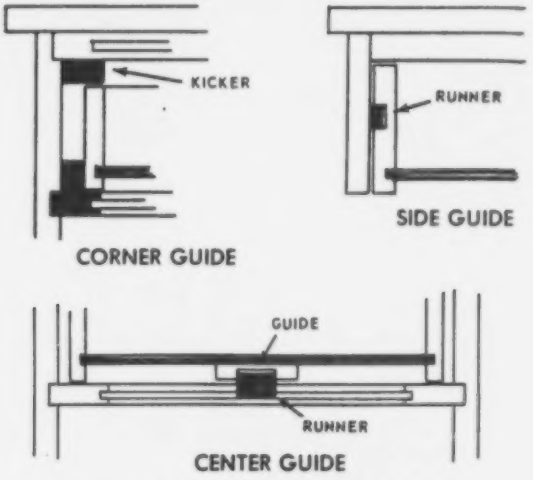


Drawer fronts are usually made of 3/4" material. The sides and back material are 3/8" or 1/2" for most drawers. The bottom of the drawer is usually 1/4" plywood or hardboard. Various joints and grooves are cut in the sides and front in drawer construction for assembly. The joints between the drawer front and side receives the greatest strain and should be carefully designed and fitted. Corner construction ranges from simple edge joint to the dovetail joint.

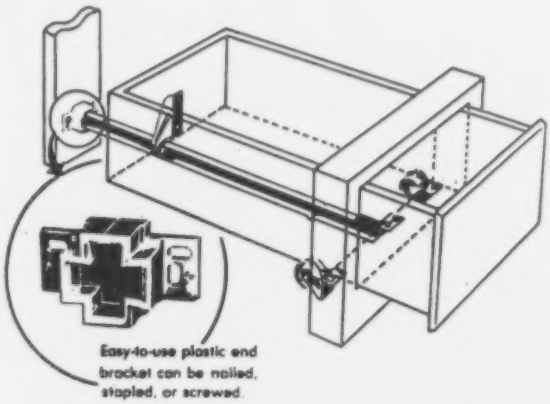


Drawer guides are used to allow the drawer to open and close smoothly while supporting the weight of the drawer and material inside. Three basic types of

drawer guides that are made on the job site are the side guides, corner guides, and center guides. Numerous types of commercial drawer guides are also available that can carry a considerable weight.

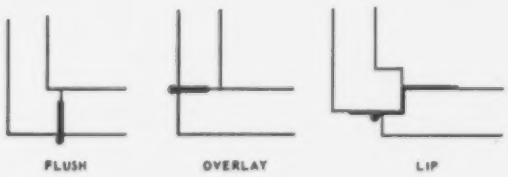


GUIDES MADE ON THE JOB

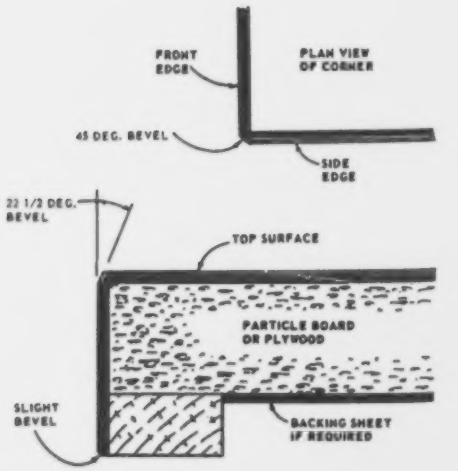


COMMERCIAL DRAWER GUIDES

Cabinet doors are classified as swinging or sliding. The swinging door is used for most kitchen cabinets. They may either be hung flush with the opening, overlap the opening, or lip the opening. The lipped doors usually have about a 3/8" lip cut around three or four sides. These doors are the most popular because they are easier cut and allow a greater freedom of fit than the other doors. Sliding doors are used where the swing of a door would be awkward or cause inference. Doors are constructed to slide in a plain groove or on commercial track like self-lubricating plastic. The doors should fit tight enough to prevent the infiltration of dust.

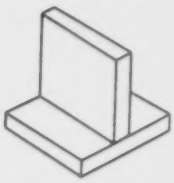


Countertops are available as prefabricated tops or they are constructed on the job site. Prefab tops are quite popular and used extensively on modern cabinets because of quality and labor saved. Countertops constructed on the job are usually a high-pressure type of plastic laminate (formica) on plywood, particle board, or hardboard. Plywood and particle board 3/4" thick are used extensively. The plastic laminate is glued to the base surfaces with contact cement. This bond requires very little pressure and the pressure is commonly applied in the form of a hand roller. The edges are then hand or machine trimmed and beveled. This provides an edge smooth to the touch and the edge wears better.

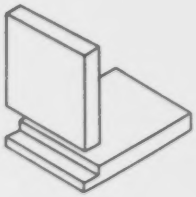


Joints are formed when two pieces of wood are fastened together with glue, nails, screws, splines, dowels, and corrugated fasteners. The following are common joints in cabinet construction:

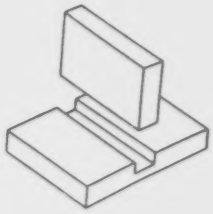
1. **Butt joints** are formed when a squared end of a board is fitted against the end or edge of another board. Butt joints are often strengthened by dowels or glue blocks.



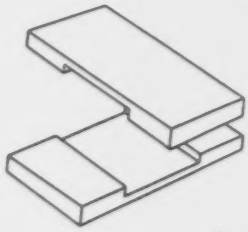
2. **Rabbet joints** consist of a grooved board recessed into the end of another board. The boards are glued together and nails, staples, or screws are usually added to strengthen the joint. This joint is used extensively in the construction of cabinet doors/drawer fronts.



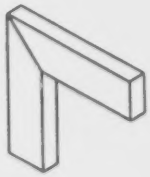
3. The **simple dado joint** consists of the end of one board recessed into a groove on the surface of another board at a certain depth. Dado joints are used extensively in drawer construction.

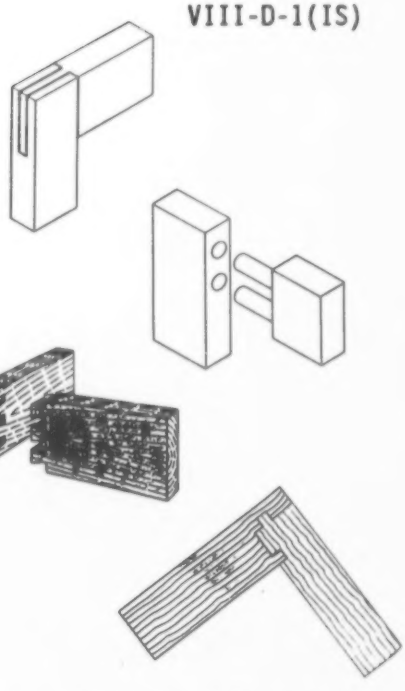


4. **Lap joints** are formed when two boards lap. Half the thickness of each board is removed and when lapped, the two boards equal the thickness of one board. The joint is simple and used extensively in frame construction.



5. **Miter joints** are formed when two boards are cut at an angle of less than 90^0 (usually 45^0) dress andjoined together. Commonly used for installing various types of moldings.





6. **The open mortise and tenon joint** is one of the most popular joint used in cabinet construction. The tenon fits into the mortise and is glued to produce a strong joint. It is commonly used in cabinet door construction.

7. **Dowel joints** are used to increase strength to edge joints. They often replace mortise and tenon joints.

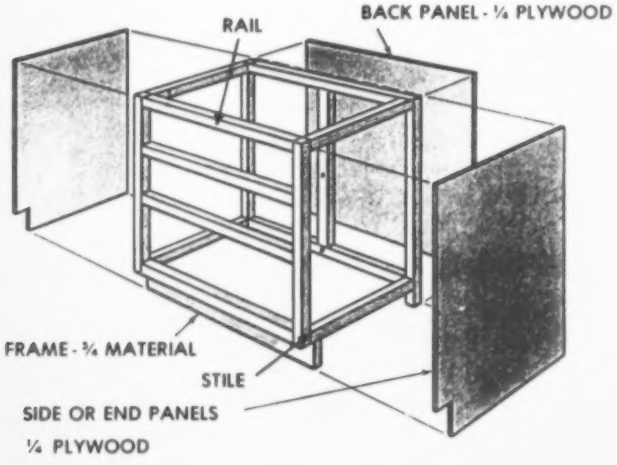
8. **Dovetail joints** are found in the finest grades of drawer construction. Requires dovetail attachment and is difficult accurately to cut in school shop.

9. **Lock joints** are found in drawer construction. Can be made on circular or radial-arm saw with dado head.

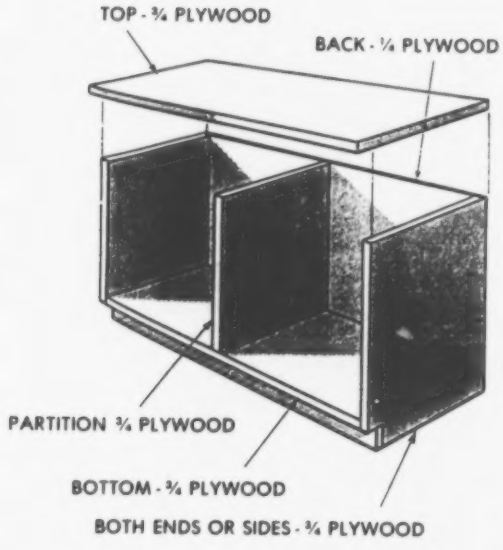
CONSTRUCTION PROCEDURES

Cabinets are constructed on the job site or are prefabricated in small cabinet shops or mass produced by a factory and then brought to the building site and installed. When built on the site, the cabinets are built piece by piece as built-ins.

The finish carpenter has two choices of cabinet construction. In the first method, a frame is constructed of solid wood framing material about 1" x 1 1/2". The frame is then covered by thin plywood and other panel stock. Drawers and doors are constructed and installed on the job.



The second choice is the non-frame or all-panel construction. The cabinet is made of plywood, particle board, or hardboard panels that serve as both the exterior of the cabinet and the structural support. The only solid wood used is for drawer guides and runners and face plate.



All base cabinets are built with a toe space 4" in height and depth varying from 2" to 3 1/2". The cabinets should have a face plate attached when flush or lip doors and drawers are used. On non-frame cabinets with overlap doors and drawers, the face plate is not needed. The counter top of all base cabinets usually extend 1" to 1 1/2" beyond the cabinet top.

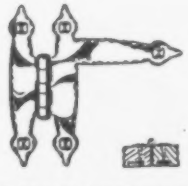
CABINET HARDWARE

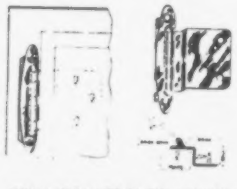
Hardware is available in many styles and qualities. Styles for hinges and pulls are Early American, Traditional, Contemporary, French, and Italian Provincial, or Spanish. Care should be used in the selection of an appropriate size, style, material, and finish that compliment the beauty, design, and serviceability of the cabinet. The following are a few examples of hinges, catches and pulls and knobs:

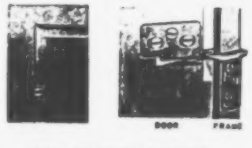
1. Hinges - basic types are surface, butt, concealed wrap-around, fully concealed, pivot, and piano.

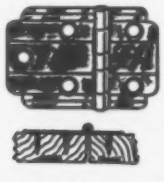
BUTT

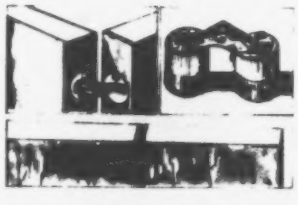
SEMI-CONCEALED


DECORATIVE SURFACE

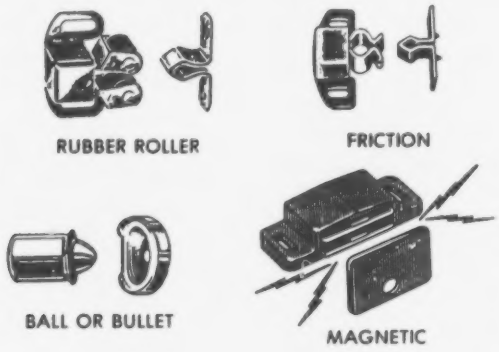

SEMI-CONCEALED HINGE


CONCEALED HINGE

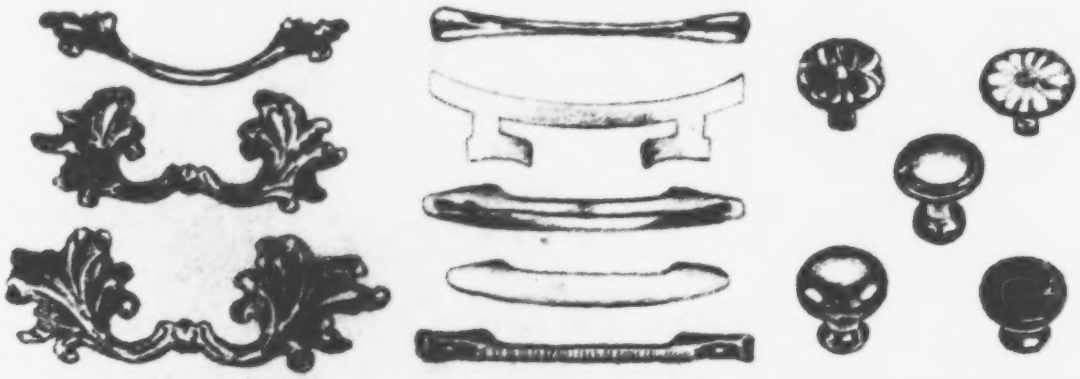

UTILITY SURFACE


INVISIBLE HINGE

2. Catches - basic types are magnetic, friction, roller, and ball or bullet.



3. Pulls and knobs - wide variety of sizes, styles and designs.



Hinges are often prefitted before the final finish is applied to built-in cabinets. Catches and pulls can be installed after the finish is applied and thoroughly dried. Layout and drill holes careful not to splinter the surface.

Drawer pulls look best when centered horizontally and located slightly above the center line of the drawer. Drilling jigs save time and insure the same location for all drawers. Door pulls are convenient when located on the bottom third of a wall cabinet door and on the top third of base cabinet doors.

SAFETY

The finish carpenter must use hand and power tools for the construction of cabinets. Care should be taken to follow the safety rules and regulations for such tools. Eye protection should be worn at all times. Ear protection is necessary when working with power tools.

When sawing and sanding is done in the shop or job site, make sure that there is proper ventilation and the work area is kept clean of sawdust and scrap lumber pieces. Good housekeeping is important.

INSTRUCTOR'S PLAN VIII-D-1(S)
MANIPULATIVE LESSON

TASK:	Install Prefabricated Kitchen/Bathroom Cabinets
AIM:	The student will be able to install prefabricated kitchen and bathroom cabinets.
TOOLS AND EQUIPMENT:	Safety equipment, tape measure, framing square, level, hand drill, twist drills, screwdriver, pry bar, hand and power saws, pencil, work bench or blocking for supporting wall units, C-clamps or hand screw clamps
MATERIALS:	As per builder's plans and specifications, prefabricated cabinets, screws, shimming material
REFERENCES:	Wagner, Willis H., Modern Carpentry, Unit 14
PREREQUISITE EXPERIENCE OF THE LEARNER:	The student must have successfully completed related lesson, VIII-D-1(I)
CHECKING STANDARDS:	Teacher: check on quality/procedure of student's work Example: 1. Selection of material 2. Accurate quantities of materials and supplies 3. Quality of work 4. Selection of tools 5. Safe work habits

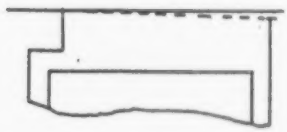
I. PREPARATION (OF THE LEARNER - MOTIVATION)

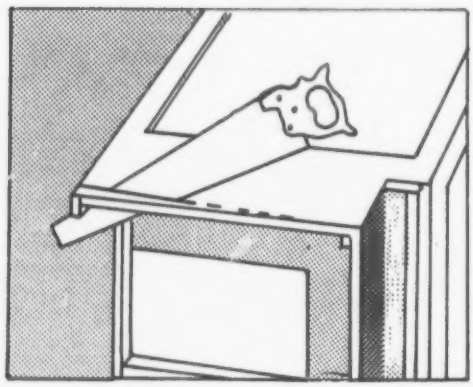
For a quality job of installing kitchen/bathroom cabinets, careful consideration should be given to: quality of work, proper installation of base and wall units, careful installation of hardware and any molding or trim. Follow the manufacturer's instructions for the installation of base and wall cabinets and prefabricated countertops. Proper planning and preparations before starting the installation of cabinets, will make the job go a lot faster and more accurate.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Material Selection	1. As per building plans, estimations 2. Check condition, return damaged materials 3. Correct screw type and size for the job
2. Preparation of Material	1. Locate and mark the position of each cabinet (wall and base units) on the kitchen wall 2. Locate and mark studs where cabinets (wall and base units) are to be fastened 3. Clean floor and wall of trash and debris

3. Installing Pre-Built Base Unit





1. Temporary place the cabinet units beginning in the corner if any
2. Level top of cabinet with back held firm to the wall

NOTE: If floor is not level use wedges to hold cabinet level

3. Measure space if unlevel and transfer the measurement to the bottom and/or back of cabinet
4. Trim the cabinet where necessary
5. Reposition cabinet and check level and fit, re-trim if necessary
6. Plumb cabinet in like manner to side

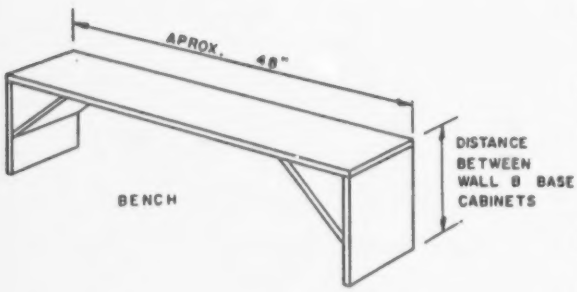
NOTE: Cabinet must be plumb and level for doors and drawers to operate properly

7. Fasten cabinet to wall with screws through the back frame into the studs as per manufacturer's instructions

NOTE: Toggle bolts are required when studs are inaccessible

8. Install other units in like manner
9. Clamp adjoining units together and when aligned (plumb and level) bolt and T-nut together
10. Cut, fit, and install toe board or other molding as required
11. Install countertop per specifications

4. Installing Pre-Built Wall Units



1. Position wall cabinet units beginning in the corner if any

NOTE: It is helpful to build a bench, placed on the countertop, on which the wall may rest

2. Shim back of cabinet at wall stud line if wall is not plumb
3. Secure cabinet back frame to wall studs with screws as per manufacturer's instructions

NOTE: Toggle bolts are required when studs are inaccessible

4. Cut, fit, and install cabinet molding as required

5. Safety

1. Observe all safety rules and regulations
2. Use the correct tools for the job
3. Be careful and use properly all power saws
4. Wear proper safety apparel (eye protection, ear protection, clothing, etc.)
5. Follow manufacturer's instructions

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates proper procedure for leveling and plumbing cabinet base units.

Instructor: Demonstrates proper installation and securing of cabinet base units.
Instructor: Demonstrates proper procedure for plumbing cabinet wall units.
Instructor: Demonstrates proper technique of supporting and installing of cabinet wall units.
Instructor: Demonstrates the proper use and safe handling of hand and power saws.
Students practice job and task under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Students install pre-built cabinet base and wall units.
Students install molding necessary for trim.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

Care planning and preparation are important in the selection and installation of kitchen or bathroom cabinets. Care and taking the necessary time are a must to install base and wall units plumb and level. Be careful not to damage or harm the cabinets while installing them.. Good housekeeping is important to provide a clean, safe work area. Use all tools safely and for the purpose they were designed for. Work safely and think of others.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 18

THE NEXT LESSON IS: VIII-E-1(S) "Base, Ceiling and Wall Molding"

JOB SHEET VIII-D-1(J)
ON
PRE-BUILT KITCHEN/BATHROOM CABINETS

NAME OF JOB: Install Cabinets

DRAWINGS: Builder's construction plans, detailed drawings

MATERIALS: As per specifications and details - pre-built cabinets, screws, shimming materials

GENERAL INSTRUCTIONS: Study the plans and specifications. Determine the best approach to installing required cabinets. Locate studs for attaching cabinet units.

Position base unit (center, if any), check levelness and plumbness. Trim back and bottom of cabinet to plumb and level cabinet. Secure unit to wall when plumb and level. Work diligently to install cabinet unit(s) plumb and level. Install necessary molding.

Care should be taken in using power and hand tools. Observe all safety rules and regulations.

PROCEDURES AND/OR TASKS: VIII-D-1(TS) Install Pre-Built Cabinets

TASK SHEET VIII-D-1(TS)

TASK: Install Pre-Built Cabinets

JOB: Install Cabinets

TRADE: Building Trades

TOOLS AND MATERIALS: Cabinets per builder's plans and specifications, screws, shimming materials, tape measure, framing square, level, hand drill, twist drills, screwdriver, pry bar, hand and power saw, pencil, work bench or blocking for supporting wall units, C-clamps or hand screw clamps

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material type and quantities 2. Familiarize self with details and dimensions
2. Material Selection	1. Check condition, return damaged materials 2. Correct screw type and size for the job
3. Preparation of Material	1. Locate and mark the position of each cabinet (wall and base units) on the kitchen wall 2. Locate and mark studs where cabinets (wall and base units) are to be fastened 3. Clean floor and wall of trash and debris
4. Installing Pre-Built Base Unit	1. Temporarily place the cabinet units beginning in the corner if any 2. Level top of cabinet with back held firm to the wall NOTE: If floor is not level use wedges to hold cabinet level 3. Measure space if unlevel and transfer the measurement to the bottom and/or back of cabinet 4. Trim the cabinet where necessary 5. Reposition cabinet and check level and fit, re-trim if necessary 6. Plumb cabinet in like manner to side NOTE: cabinet must be plumb and level for doors and drawers to operate properly 7. Fasten cabinet to wall with screws through the back frame into the studs as per manufacturer's instructions NOTE: Toggle bolts are required when studs are inaccessible 8. Install other units in like manner

STEPS	KEY POINTS
	9. Clamp adjoining units together and when aligned (plumb and level), bolt and T-nut together 10. Cut, fit, and install toe board or other molding as required 11. Install countertop per specifications
5. Installing Pre-Built Wall Units	1. Position wall cabinet units beginning in the corner if any NOTE: It is helpful to build a bench, placed on the countertop, on which the wall cabinet may rest 2. Shim back of cabinet at wall stud line if wall is not plumb 3. Secure cabinet back frame to wall studs with screws as per manufacturer's instructions NOTE: Toggle bolts are required when studs are inaccessible 4. Cut, fit, and install cabinet molding as required

INSTRUCTOR'S PLAN VIII-E-1(I)
INFORMATIONAL LESSON

SUBJECT: Base, Ceiling and Wall Molding

AIM: The student will be able to install finish trim efficiently and in a craft-like manner following builder's blueprints and specifications.

TEACHING AIDS: Information Sheet VIII-E-1(IS), chalkboard/chalk, transparencies (interior trim)

REFERENCES: Wagner, Willis H., Modern Carpentry, Unit 17

PREREQUISITE EXPERIENCE OF THE LEARNER: The student(s) must have successfully completed previous lessons in Major Block VIII. The student(s) must also exhibit a sincere interest in learning the building trades while meeting the requirements of the Texas Education Agency and local school district.

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Moldings are thin strips of wood, plastic, or metal in a wide variety of types, shapes, and sizes. Moldings are available in lengths ranging from 3 to 16 feet. They have multitude of uses and are essential in the enhancement of a particular architectural style. Care should be taken in selecting and installing of the molding. The installation of molding is a job of the finish carpenter.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTORS TO DO OR SAY
A. Purpose of Molding	1. Development of a particular architectural style a. Defines b. Enhances 2. Cover unsightly joints 3. Reduces maintenance 4. Adds rigidity to construction 5. Decorative effect on flush doors or cabinets
B. Basic Groups and Use of Wood Molding (Show Examples)	1. Base - used where wall and floor meet a. Protects wall covering b. Provides a finished look c. Base shoe is added to conform to uneven floor lines 2. Ceiling - used at top of wall where the ceiling and wall meet a. Softens sharp lines b. Mixed with other molding for a variety of effects 3. Wall - emphasizes the decorative theme
C. Basic Joints Used to Install Wood Molding	1. Scarf - 45^{0} splice to continue run of molding

2. Coped - used on inside corner
   a. Take a little longer
   b. Better joint at inside corner than a miter
   c. Won't open when molding is nailed in place
   d. Less noticeable crack if shrinkage occurs later
   e. May be mitered
3. Mitered - used on outside corners, scarf joints and cut to serve as guide for cutting a coped joint

D. Other Molding Materials

1. Metal
   a. Aluminum for predecorated panels of wallboard
      1) Divider
      2) Inside corner
      3) Outside corner
      4) Cap
   b. Permanent veneer applied to exterior surface
2. Plastic - colored and grain-effect for matching wood

E. Fasteners and Fastening Techniques

1. Nails - most popular fastener
   a. Finish
   b. Painted paneling nail
   c. 4d, 6d, 8d or long enough to get a solid bit into framing member
2. Adhesives - polyvinyl glues for miter joints
3. Nail setting techniques

F. Basic Tools Used

1. Miter box and saw - hand or power, mitered joints
2. Coping saw - for coped joints
3. Hammer - claw
4. Nail set
5. Nail gun
6. Corner clamp

G. Installation Procedures

1. Layout and measurement
2. Cut and fit scarf and inside and outside corners
3. Securing

H. Related Safety

1. Clothing and equipment
2. Scaffold/ladder

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have student(s) discuss the purpose and use of molding.
2. Discuss with the student(s) the basic types of moldings used in carpentry.
3. Take field trip with student(s) to construction side where molding is being installed.
4. Discuss with the student(s) the basic joints used to install wood molding.
5. Discuss with the student(s) the fasteners and tools needed for installing molding.
6. Discuss with student(s) the proper and safe use of power equipment such as nail or brad gun and power miter saw.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

Simple Recall

1. Molding is used to conceal and cover unsightly _____.	joints
2. Ceiling, _____, and wall molding are the three basic groups of molding used in carpentry.	base
3. _____ molding is used where the wall and floor join.	base
4. _____ molding is used where the ceiling and wall meet.	ceiling
5. The _____ joint is a 45^{0} splice to continue the run of molding.	scarf
6. A _____ joint is used for inside corners.	coped
7. A _____ joint is used for outside corners.	mitered
8. _____ are the most commonly used fasteners for securing molding.	nails
9. A _____ saw is used to cut a coped joint.	coping
10. A _____ box and handsaw are used to cut a miter joint.	miter

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

Moldings are thin strips of wood, plastic or metal used to accent architectural style, cover unsightly joints, reduce maintenance, add rigidity to construction, and add a decorative effect on flush door or cabinets. Three basic groups of molding used by the carpenter and they are: base, ceiling, and wall molding. The name of the group general designate the location of installation.

The scarf, coped, and miter joints are used to fit molding together. Nails are the most commonly used fasteners for securing molding. Tools used for installation are miter box and saw, coping saw, claw hammer, nail set, nail gun, and corner clamp.

Follow safety rules and regulations when working with hand and power tools. Wear the proper safety apparel at all times. Use the right tool for the job.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 17

THE NEXT LESSON IS:

INFORMATION SHEET
ON
FINISH TRIM

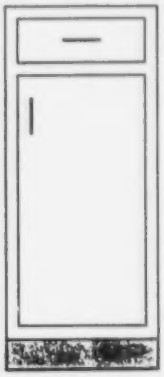
VIII-E-1(IS)

SUBJECT: Base, Ceiling, and Wall Molding

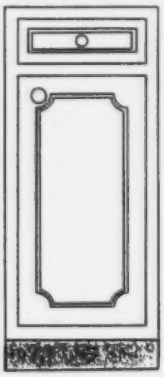
INTRODUCTORY
INFORMATION:

Molding of wood, plastic, and metal are used to trim (finish touch) out a room, cabinets, and exterior part of a house. Molding of varying styles, shapes, and sizes are used to define architectural styles, cover unsightly joints, reduce maintenance, add rigidity to construction and add a decorative effect to flush door and furniture design.

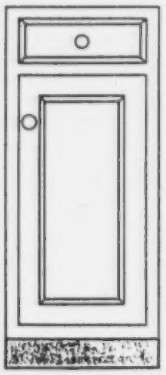
Moldings are important on all built-in furniture because they give a finished look to cabinets, closets, desks, and shelving. Furniture and cabinet manufacturer's make use of many kinds of moldings that are glued, stapled, and/or glued to the surface of drawers, doors, and edges of case work. Manufacturer's of kitchen cabinets often use the same basic casework and change only the molding and hardware to create a different style.



BASE CABINET



FRENCH PROVINCIAL



EARLY AMERICAN
OR COLONIAL

GENERAL INFORMATION:

PURPOSE OF MOLDING

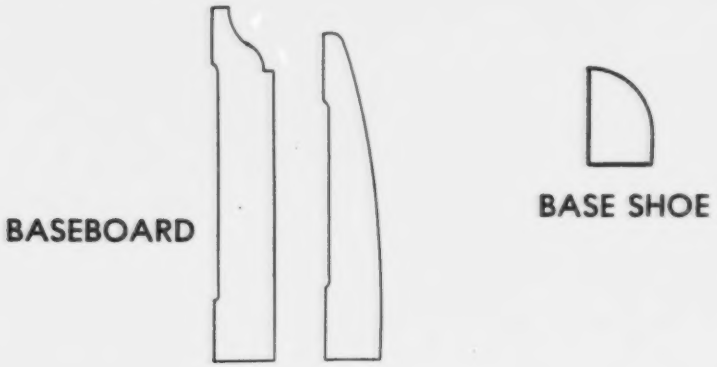
Moldings have a multitude of uses, both practical and decorative. From the practical side, molding adds rigidity to construction such as door casing that secures the door frame to the wall and makes the jambs rigid to they will carry the door. Another example is the use of outside corners to protect wall corners and reduce maintenance of wall covering at the corners.

Molding, from the decorative point, is used to define the architectural style of a room. Unsightly joints are covered by molding that softens sharp lines where two planes meet. Molding may also be applied to the surface of cabinets, doors, drawers, desks, and shelving to give a finished appearance.

BASIC GROUPS AND USE OF WOOD MOLDING

Different types of molding are put into three basic groups for molding according to the location of use in a particular room. These groups are:

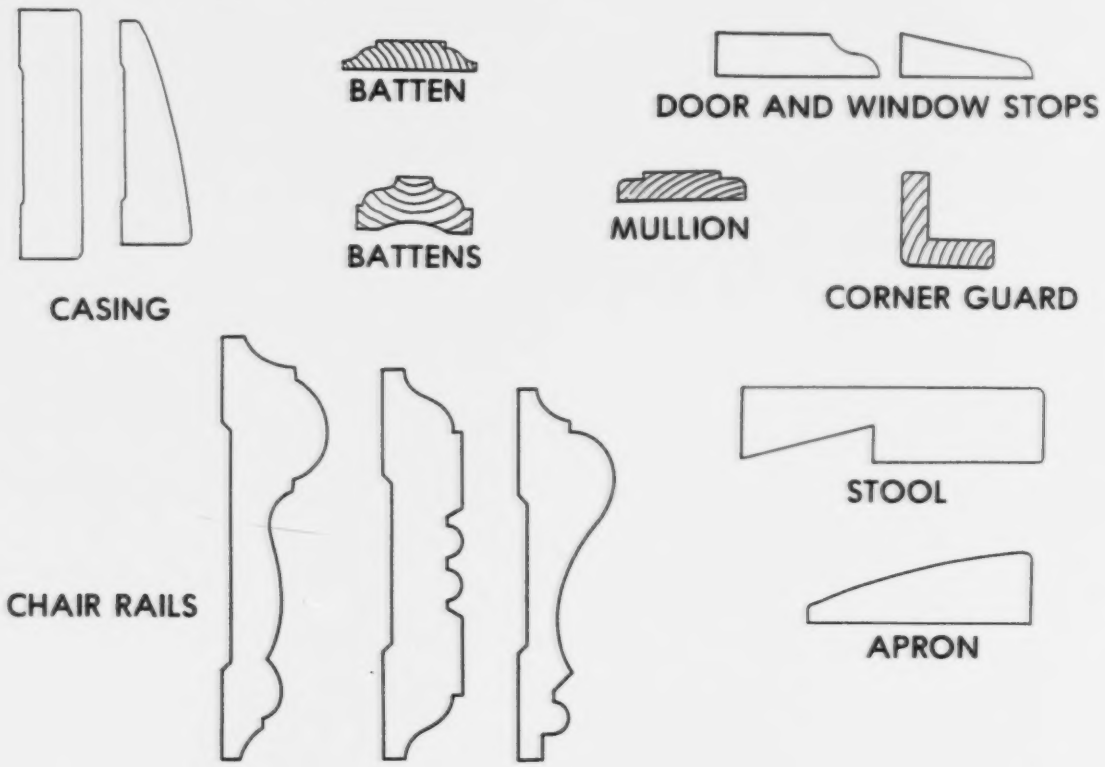
1. **Base molding** is used to cover the joint where the wall and floor intersect. The molding protects the wall covering from household items as vacuum cleaners and rug shampooer. The molding also provides a finish look to the room. Three (3) inch and four (4) inch tall base is used in a room having 8' ceilings and should be increased in height if the ceiling increases. Base molding and base shoe are often used in combination to better conform to uneven floor lines. The base molding is undercut to permit a snug fit to the wall where slight irregularities are present.



2. **Ceiling molding** is used to cover the joint where the wall and ceiling intersect. These moldings soften the sharp lines where the two planes meet. Common crown and cove are the two most used types of ceiling molding. Other molding used are quarter round, and bed molding. These moldings are often mixed and matched to produce a variety of effects throughout the room.

3. **Wall molding** is usually used to add the final decorative effect to wall coverings such as wallboard or paneling. Others such as casing, chair rail, and corner guard molding offer protection to the wall. As with ceiling moldings, various types of molding are used in combination to provide a variety of wall

transitions. Moldings used around windows and doors make a major part of the molding used on the wall.



Wood moldings are available with unfinished or prefinished exterior surfaces. Unfinished moldings are stained to harmonize or contrast the wall covering. For example, a molding may be stained to match paneling or stained to a darker color to accent a light-colored birch paneling. When installing unfinished molding, countersunk nail holes should be putted with a clear putty so that it will color or stain with the same appearance as that of the solid wood molding.

Prefinished wood molding has a factory-applied finish. This eliminates finishing on the job and provides a durable surface that resist wear. Colored nails may be used to fasten the molding in place and eliminates the countersinking of the nail heads. Color-coordinated putt sticks can be used when finish nails are countersunk. The putty sticks can also be used to cover deep scratches as well as nail holes.

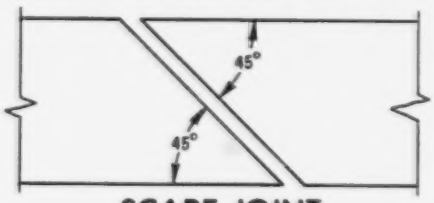
Nails, finish or colored, are the most popular method of fastening molding. Finish nails require that the head be countersunk slightly below the surface. A nail set is the tool required to perform this task. Colored nails do not have to be countersunk. Miter joints on wall moldings are often glued and nailed together. A polyvinyl (white) glue is the most popular adhesive used.

GLUED THEN BOTH ENDS NAILED

BASIC JOINTS USED TO INSTALL WOOD MOLDING

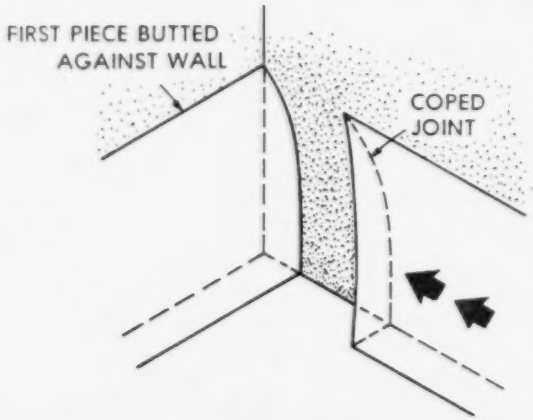
To cut and fit molding, three basic joints are used. They are:

1. **Scarf joints** are a 45° splice to continue the run of the molding. Two mitered joints are joined together forming the scarf joint.

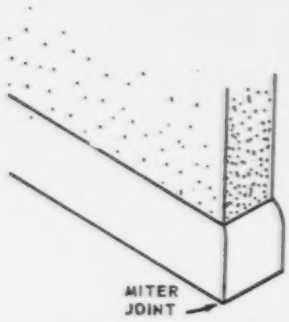


SCARF JOINT

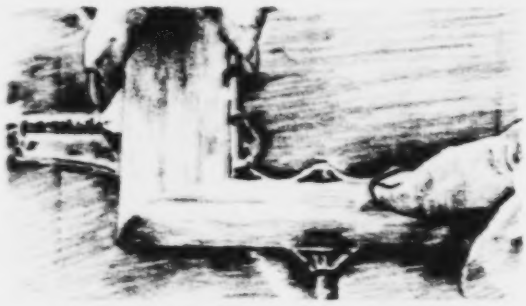
2. **Coped joints** are used on inside corners. The coped joint requires a little more time, but produces a better fitting and more appealing joint than a miter joint. To cut this joint, an inside miter is cut on the end of the molding. With a coping saw, cut along the profile of the 45° cut to form an end profile that will match the face of the molding it is to be fitted against.



3. **Miter joints** are the basic joints used for fitting most all moldings. Two mitered cuts are the foundation of a scarf joint. The first cut of a coped joint is a mitered cut. Outside corners are mitered to form the proper fit. Wall molding, for decorative effect, involve mostly miter cuts and then framed together to provide a variety of wall transitions.



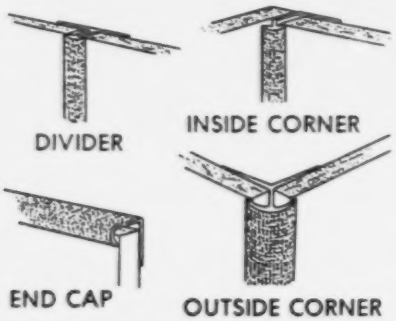
OUTSIDE CORNER



FRAMING WALL MOLDING

OTHER MOLDING MATERIALS

Aluminum extruded moldings are used with predecorated panels of gypsum wallboard and plastic laminates for table or countertops. They have a veneer to match the surface used that is permanently bonded to the exposed surface. Stainless steel extrusions are also used on table and countertops. Common types are illustrated below.

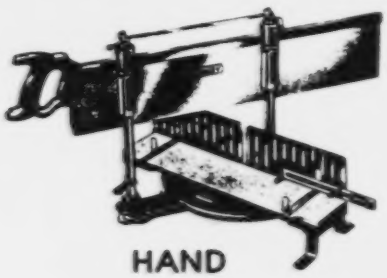


Plastic moldings are available in many of the standard shapes for wood. The exposed surface has a grain-effect and/or color that matches or contrasts the wall covering, paneling, and other location that it is used in.

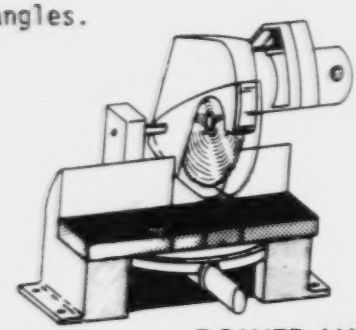
BASIC TOOLS USED

The following are the basic tools used to install trim molding. Care should be taken in the selection and use of the tools. Remember to observe all safety rules and wear the proper safety apparel at all times. Think of yourself and others around you.

1. Miter box and saw - cuts 45°, 90° or various angles.

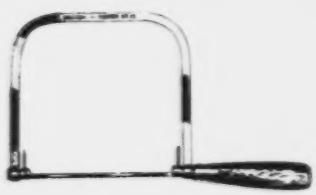


HAND



POWER MITER SAW

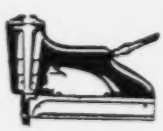
2. Coping saw - for coped end joints.



3. Claw hammer - prying, removing and driving nails.

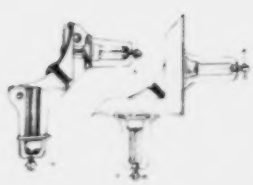
4. Nail set - for countersinking nail heads.

5. Power nailer - more efficient method of fastening.



BRAD AND STAPLE NAILER

6. Corner clamp - for clamping frames of wall molding



SAFETY

When using hand and power, care should be taken to follow the safety rules regulations for such tools. Eye protection should be worn at all times. Be careful with placement of fingers when sawing and hammering. Work off ladders or scaffolding safely.

INSTRUCTOR'S PLAN VIII-E-1(S)
MANIPULATIVE LESSON

TASK:	Install Base, Ceiling, and Wall Molding
AIM:	The student will be able to install base, ceiling, and wall molding.
TOOLS AND EQUIPMENT:	Safety equipment, pocket tape, pencil, hammer, nail set, miter box and saw, coping saw, corner clamps, ladder or scaffolding, sawhorses
MATERIALS:	As per builder's plans and specifications, molding, nails, glue, wood putty
PREREQUISITE EXPERIENCE OF THE LEARNER:	The student must have successfully completed related lesson, VIII-E-1(I)
CHECKING STANDARDS:	Teacher: check on quality/procedure of student's work Example: 1. Selection of material 2. Accurate quantities of materials and supplies 3. Quality of work 4. Selection of tools 5. Safe work habits

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Precision is the key word in working with and installing moldings: precise measurements, careful cutting, skillful use of hammer and nail set, filling of nail holes, and painting or staining. Measure each piece of molding separately for the area it will occupy. Don't assume that floor and ceiling lengths are identical. Make allowances for miter cuts.

II. PRESENTATION (OF THE SKILLS)

STEPS	KEY POINTS (THINGS TO REMEMBER TO DO OR SAY)
1. Material Selection	1. As per building plans, estimations 2. Check condition, return damaged materials 3. Correct nails and glue for job
2. Preparation of Material	1. Clean floor and wall of trash and debris 2. Finish molding if different color than wall
3. Install Molding A. Base Molding B. Ceiling Molding	NOTE: Different types of moldings are required, for each, but the installation is the same 1. Measure along one wall or ceiling 2. Layout measurement to molding 3. Make appropriate cuts

NOTE: Miter (45°) cuts are normally made for corners or where molding is spliced (scarf joint)

4. Position baseboard or ceiling molding and nail it in place using 6d-8d finishing nails

NOTE: At this point, the molding has been placed against one wall with a butt joint in each corner

5. Continue around the room installing molding with coped joints at inside corners; miter joints at outside corners and splice runs with scarf joints
6. If a base shoe is used, install the same way as for base.

NOTE: Care should be taken in nailing and countersinking nails so as not to damage molding

4. Installing Wall Molding

1. Measure width and length of area to be framed
2. Transfer measurement to molding and cut 45° miters

NOTE: Make allowance of material for miter cuts

3. Place molding ends in corner clamp, glue and nail corners. Remove excessive glue

NOTE: Construction is like building a picture frame

4. Countersink nail heads 1/16" below surface and fill
5. After putty has dried, sand lightly

NOTE: It is usually advantageous to finish the wall molding before securing it, especially if different colors than wall covering

6. Fasten the molding in place with 6d nails, level and plumb or use chalkline as a guide
7. Fill nail holes properly

NOTE: Chair rail and casing is considered wall molding, but is installed in a manner like base and ceiling moldings

5. Safety

1. Observe all safety rules and regulations
2. Use the correct tool for the job
3. Wear proper safety apparel (eye and ear protection, clothing, etc.)
4. Be careful with ladders and scaffolding

III. APPLICATION (PRACTICE BY LEARNER UNDER CLOSE SUPERVISION)

Instructor: Demonstrates proper procedure for installing base, ceiling, and wall molding.

Instructor: Demonstrates the proper procedure for cutting and forming coped, mitered and scarf joints.
Instructor: Demonstrates the proper use and safe handling of all tools.
Instructor passes out job and task sheet.
Students practice job and task under supervision of instructor.

IV. VERIFICATION AND/OR EVALUATION (CHECK ON STUDENT'S ABILITY)

Performance Test!

Students install base, ceiling, and wall molding.

V. SUMMARY (TELL THE STEPS ON PROCEDURE AS TO WHAT, HOW, AND WHY. REVIEW CHECKING STANDARDS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENTS.)

Take the time to measure correctly, cut accurately, install without damage, and finish properly all types of moldings. Tools in good condition, like sharp saws, makes the forming of tight joints possible. Use all tools safely. Keep area clean and free from clutter.

SUGGESTED READING FOR STUDENTS:

Modern Carpentry, Unit 17

THE NEXT LESSON IS:

JOB SHEET
ON
INTERIOR MOLDING

VIII-E-1(J)

NAME OF JOB:	Install Interior Molding
DRAWINGS:	Builder's construction plans, details and elevation drawings
MATERIALS:	As per specifications and details - molding, nails, glue, wood putty
GENERAL INSTRUCTIONS:	Study the plans and specifications. Precision is the key in working with moldings. Coped joints should be used on inside corners, miter joints at outside corners, and splice runs with scarf joints. Observe all safety rules and use tools and equipment safely.
PROCEDURES AND/OR TASKS:	VIII-E-1(TS) Install Base and Ceiling Molding VIII-E-1a(TS) Install Wall Molding

TASK SHEET VIII-E-1(TS)

TASK: Install Base and Ceiling Molding

JOB: Install Interior Molding

TRADES: Building Trades

TOOLS AND MATERIALS: Safety equipment, pocket tape, pencil, hammer, nail set, miter box and saw, coping saw, corner clamps, sawhorses, ladder or scaffolding, molding, nails, glue, wood putty

TASK BREAKDOWN:

STEPS	KEY POINTS
1. Study Plans and Specifications	1. Determine material types and quantities 2. Familiarize self with details and dimensions
2. Material Selection	1. Check condition, return damaged materials 2. Correct nails and glue for job
3. Preparation of Material	1. Clean floor and wall of trash and debris 2. Finish molding if different color than wall
4. Install Molding A. Base Molding B. Ceiling Molding	NOTE: Different types of moldings are required for each, but the installation is the same 1. Measure along one wall or ceiling 2. Layout measurement to molding 3. Make appropriate cuts NOTE: Miter (45^{0}) cuts are normally made for corners or where molding is spliced (scarf joint) 4. Position baseboard or ceiling molding in place using 6d-8d finishing nails NOTE: At this point, the molding has been placed against one wall with butt joint in each corner 5. Continue around the room installing molding with coped joints at inside corners; miter joints at outside corners and splice runs with scarf joints 6. If a base shoe is used, install the same way as for base NOTE: Care should be taken in nailing and countersinking nails so as not to damage molding

TASK: Install Wall Molding

JOB: Install Interior Molding

TRADES: Building Trades

TOOLS AND MATERIALS: Safety equipment, pocket tape, pencil, hammer, nail set, miter box and saw, coping saw, corner clamps, sawhorses, ladder or scaffolding, molding, nails, glue, wood putty

TASK BREAKDOWN:

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